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PENSIONS FOR ALL.

By General M. M. TRUMBULL.

IN the wondrous literature of the time there is hardly anything so glaring and sensational as the report of the Commissioner of Pensions explaining the work of his department for the year ending June 30, 1888. In that report he says: "The total amount expended for all purposes by the Bureau of Pensions was $82,038,386.59. The total expenditures of the Government for the fiscal year 1888 were $267,924,801.13. Thus it will be seen that the amount expended for and on account of pensions was nearly thirty-one per cent of the entire outlay of the Government."

In round numbers, one third of the public payments goes for pensions, and it is gravely proposed that the pensioners have the other two thirds also. A few days ago the Governor of Illinois, speaking to the Illinois department of the Grand Army, said, "If the Government paid $1,000,000 daily for pensions, the nation as a nation would be just as rich at the end of the year as it was before, as the money would still be in the hands of our own people."

To take a million dollars a day from industry and bestow it upon idleness is a patriotic form of dragoonade much recommended by politicians like the Governor of Illinois. The "nation as a nation" is not injured by it; the money is still in the hands of our own people. It is merely taken out of the hands that earned it and put into other hands to spend it.

In Whittier's delightful poetry we are cheered by the information that

> ". . . Barbara Frietchie's work is o'er,
> And the rebel rides on his raids no more."

True, the rebel raiders have dismounted, but the "boys in blue" have sprung into the vacant saddles and the raids go on.

The point of attack is the national treasury. The cry is, "On to Washington!" The new foray is not the sudden dash of a scouting party; it is literally the charge of an army. The brazen throats of the bugles and the buglers ring out the inspiring slogan, "Pensions for all!"

Is there no moral resistance in the people? Must the guardians of the public money throw up their hands, while the foragers carry off the national cash-box? Or must they buy off the raiders as once upon a time the Romans bribed the Gauls?

A comprehensive pension system corrodes the heart of government and beguiles a people into servitude. A caste composed of pensioners is always the defender of existing wrongs. It believes that all reforms are assaults upon its own privileges and that public honesty is dangerous. It can always be depended on to support the pensioning power. The history of England shows how worthless ministries have retained office for years by a judicious distribution of pensions. National alms-giving weakens public spirit as it conquers private virtue.

In the United States we have converted civil offices into gifts called patronage, and pensions will share the same fate. Where public offices are legal tender in payment for party services, pensions will become so too. To a dangerous extent they are used as political currency now. By a skillful use of pensions the party in power can bribe one portion of the people with the money of the other.

With the warnings of all history before us, we submit to the corruption of our politics by a pension system heavier than was ever laid upon any other people since governments began. No monarchy, no hierarchy, no oligarchy ever had the daring to put so many idlers under public pay as we have placed there by our pension laws. Some of us think that consequences do not follow causes in republics as in the "effete monarchies," and that we can dignify our people by an alms-tribute that would debase the people of those benighted lands across the sea. With much vehemence we exclaim: "Pensions are not a king's prerogative here; they are the free gifts of a free people. Pensions can not corrupt us. The Asiatic cholera is harmless here, because it is not an American disease."

It has never been suspected that the warriors who subdued the great rebellion, who marched and counter-marched over half a continent and fought a thousand battles, were a puny, sickly race of men. Yet this is the inference we must draw from the official testimony of the Commissioner of Pensions. In his report for 1888 he says, "It thus appears that in the aggregate 1,166,926 pension claims have been filed since 1861, and in the same period 737,200 claims have been allowed."

This includes, of course, the claims of widows and dependent relatives. Although many have been dropped from the rolls by reason of death and other causes, the actual number of old soldiers on the pension-list is 323,020, while there are thousands of claims on file not yet adjusted by the Pension Bureau.

It is pretended that, although the soldiers were sound and hearty when they went into the army, they were enfeebled by hardship and disease when they came out of it. Some of them were, but not many in proportion to the whole number in the ranks. The great parade at Washington in 1865 is a sufficient refutation of that claim. The athletic and boisterous armies which marched in review before the President of the United States at the close of the war were not composed of sickly and vitiated men. They were fairly rollicking with health, they were full of "lusty life." Yet we are told they carried millions of mortal microbes in their knapsacks and all manner of diseases latent in their blood—diseases which needed only pension laws to develop them into activity.

Colossal as are the figures presented by the Commissioner of Pensions, they are to be multiplied six times when Congress finally capitulates to the Grand Army. Even in their present rudimentary form they make the English pension-list cheap and tawdry by comparison. Last year the English pension-roll contained the names of 156,492 persons altogether, who drew from the treasury £7,815,575, of which amount the army pensioners (97,004) drew £3,789,282, and the navy pensioners (38,366) drew £2,040,659. The Financial Reform Association of England, commenting on this exhibit, says: "John Bull will do well to notice that in these last five years of bad trade he has had to pay an army list of over 100,000 pensioners (military, naval, and civil) for doing nothing; and that their drawings, amounting to nearly eight millions, swallowed up the whole of the income-tax laid on the national profits for last year."

The complaint is valuable as a caution to "Brother Jonathan." He has had to pay three or four army corps, each as large as the one criticised by the Financial Reform Association of England, and it is proposed that they shall be recruited to their full capacity by adding to their numbers twice six hundred thousand more.

The pension-roll of England is very much larger than it was a hundred years ago when John Philpot Curran poured upon it the following sarcasm: "This polyglot of wealth, this museum of curiosities, the pension-list, embraces every link in the human chain from the exalted excellence of a Hawke or a Rodney to the debased situation of the lady who humbleth herself that she may be exalted; but the lesson it inculcates forms its greatest perfection.

It teaches that sloth and vice may eat the bread which virtue and honesty may starve for after they have earned it; it teaches the idle and the dissolute to look up for that support which they are too proud to stoop and earn; it directs the minds of men to an entire reliance on the ruling powers of the state."

This condemnation will apply in general terms to every pension system. It is impossible to limit pensions to rewards for sacrifice and service. Favoritism and fraud will crowd the pension ranks with pretenders. Every crippled soldier who has really been disabled by battle-wounds must share his earned reward with men who never did a dollar's worth of service. He must drag along with him to the pension-office a dozen "comrades" who never saw a battle and who never received the slightest injury to body, health, or limb.

"Veteran diseases" are those miraculous ailments which rage unsuspected in the bodies of old soldiers until seductive pension laws bring them to the notice of the sufferers. The Arrears of Pensions Bill is responsible for over a hundred thousand veteran diseases. This law was in existence about two years, and expired by limitation July 1, 1880. In 1878, the year before the law went into operation, the pension applications numbered 18,812. In 1879, under the stimulus of the act, they rose to 36,835. In 1880 they reached the shameful dimensions of 110,673. In 1881, the law having expired, the number of applications fell to 18,455. The Arrears of Pensions law invited the Grand Army to loot the treasury, and 110,673 veterans accepted the invitation. The number of applications filed the year before the law and the year after it, prove that the 110,673 extra diseases were made not by the war, but by the Arrears of Pensions Bill. The bribe offered by Congress put a hundred and ten thousand additional names on the sick report for 1879 and 1880.

The crippled and wounded soldiers, whose battle-scars were vouchers to their honesty and sacrifice, did not receive any benefit from the Arrears of Pensions law. They were already on the pension-rolls. All the booty was divided among the men who suddenly discovered that they were suffering from diseases of which they had been ignorant for fifteen years. The moral enormity of this proceeding is revealed in the fact that every one of those claims was attested by the solemn oath of the claimant.

The law of compensation pervades all things, and it applies here. If pension laws are potent in the making of diseases, pensions themselves have the opposite effect—they cure them. There is nothing that promotes longevity like a pension. It is now seventy-seven years since the War of 1812 began and seventy-four years since it ended. Yet there are nearly a thousand men on the pension-rolls who claim that they were soldiers in that war.

There is a delightful contrast between the rugged and healthy state of the old veteran after his pension has been allowed and his decrepit condition before the allowance. I know a man who was simply a harbor of refuge for diseases until he obtained his pension, and then they disappeared. Having drawn his "arrears," he prudently took out a life-insurance policy. The affidavit on which he obtained his insurance curiously contradicted the affidavit on which he got his pension, proving that the pension had restored him to health and made him a "good risk" for the insurance company. The department was greatly shocked on learning the facts, and revoked the pension; but, on discovering that the delinquent was a good caucus warrior and a hustler at the polls, the department became shocked at its own imprudence and restored him to the "nation's roll of honor."

It is not irony or sarcasm to say that the insurance companies can afford to give lower rates to old pensioners than to other people, because the pensioners' chances of long life are greater than the chances of other men. The commissioner's figures prove this. He reports that the number of the pensioners of 1861 to 1865 who died in 1888 was only two per cent of the three hundred thousand pensioners on the rolls, most of whom must be between forty-five and sixty-five years of age, and all of whom are legally and officially suffering from wounds and diseases contracted in the army. Three hundred thousand healthy citizens of the like age will show a larger mortality than those diseased pensioners can show. This proves that a large proportion of those "veteran diseases" are fictitious.

Still more miraculous is the power of pension laws to bring dead men back to life. Year after year the "Mexican War Pension Bill" was rejected by Congress. At last the claim agents proved by the tables of mortality that the Mexican War soldiers were nearly all dead. That war, they said, was an insignificant affair; our army in Mexico was small, and the surviving members of it could not be numerous after the lapse of forty years. Besides, it was invidious to be generous to the soldiers of the late war and niggardly to the soldiers of Mexico. This plea carried the bill through. It was passed on the 29th of January, 1887, and before the 1st of March, 1889, 21,296 surviving soldiers of Mexico, and 7,742 widows, had filed their claims for pensions under the law. On the very face of the returns it is evident that most of those claims are without any of that merit or grace whereby pensions are justified, namely, service in battle, or at least on the genuine theatre of war during the time of active hostilities.

How happens it that so many Mexican War veterans spring up out of the ground, like Roderick Dhu's freebooters, at the clarion call "to pensions"? Not one tenth of those claimants ever saw a

battle. Here is the explanation of the miracle. Taylor's last fight was at Buena Vista, where he had less than five thousand men. Many of these had also fought at Palo Alto, Resaca de la Palma, and Monterey. It is liberal to say that all the battle-soldiers of Taylor did not exceed ten thousand. Scott's last fight was at the city of Mexico, where he had about eleven thousand men. Many of these were the same soldiers who had fought at Cerro Gordo, Contreras, Churubusco, Chapultepec, and Molino del Rey. Scott's real battle-soldiers could all be included within a total of twenty thousand men. Allowing for losses of all kinds, it is not likely that more than twenty thousand battle-soldiers of the American army in Mexico were alive at the close of the war in 1848. It is not likely that two thousand of them are living now. Every one of these is compelled to lead nine comrades under the flag of booty to the gory field of pensions. Where does he get the nine? He gets them from the army of redundance, thus:

Although the fighting ended in September, 1847, when Scott captured the city of Mexico, peace was not declared until June, 1848. This nine months' interval was passed in "negotiations." This valuable time was wisely employed by our Government in re-enforcing the American armies in Mexico, so that our invincible numbers might act as a moral pressure upon the Mexicans, convincing them how hopeless was their cause. This policy was successful. The Mexican Government, deeming further resistance useless, ratified the Treaty of Querétaro.

From September, 1847, until June, 1848, new regiments, companies, and detachments were poured into Mexico to re-enforce the divisions already there, so that only a small fraction of the army that marched home did any fighting in the Mexican War. Shiploads of soldiers arrived at Vera Cruz in June, before the ratification of the treaty of peace was known at Washington. They were ordered back without being permitted to disembark, because, peace having been declared while they were on the way, there was no necessity that they should land. It is this overflow army that now swoops down upon the Capitol, augmented by the home troops, who did garrison duty at the various posts in the United States during the war, and now march into the treasury by file left, under the pretense that they also are soldiers of Mexico. They can as truthfully claim to be soldiers of Austerlitz.*

Pensions pauperize the character and abase the souls of men, especially those men who have no scars to show. They poison honest pride and make nobility itself ignoble. They paralyze conscience and weaken self-respect. To obtain and retain pensions men will scruple not at perjury. Men of the highest rank

* The benefits of the act are limited to men over sixty-two years of age, so that the soldiers of Mexico who were under twenty-one at the close of the war are yet to hear from.

will stoop to mendicancy for a pension they do not need. Pope asks:

> "What can ennoble sots or slaves or cowards?
> Alas! not all the blood of all the Howards."

And yet a pension can *un*-noble the chief of all the Howards, and reduce him to ignominious pauperism. The Duke of Norfolk, with an income of two millions of dollars a year, is on the pension-list of England for sixty pounds a year. This pension was granted to his ancestor by the gentle Richard III. Nobody knows why. It may have been for smothering the princes in the Tower. It could not have been for anything very good, because Richard was not in the habit of rewarding virtue; yet for more than four hundred years the Dukes of Norfolk, chiefs of all the Howards, have asked for and received this degrading outdoor relief. We, too, can fall to the same base level by the same process of gravitation, as the following testimony shows:

When the Mexican War Pensions Bill passed, the "honor" of being the first man to claim his dole and get it was given to a prominent and wealthy citizen of Kentucky, who did not need the alms any more than the Duke of Norfolk needed the charity of sixty pounds a year. Yet he took it, and was applauded for his promptness by the press as if he had done a patriotic deed. Such demoralizing power has a pension.

It is true that we have no hereditary pensions yet extending beyond the third and fourth generation, but we have made a fair beginning, and may hope to enjoy that high-caste luxury in gorgeous blossom after it shall be withered and dead in England. The "royal prerogative" is now exercised by Congress, with a profuse liberality exceeding that of kings. Our senators and representatives are creating a pensioned aristocracy out of the consanguineous relics of naval and military officers, official dignitaries, and successful politicians, many of whom had no claim to recognition except that their public lives were laboriously spent in the private service of themselves.

The "retired system" is a high-toned pension scheme, available only to those who have taken the superior degrees in the order. This is borrowed from the "half-pay" and "retiring" system of England, where it had a logical and consistent reason for existence, under the social law which decreed that no man should earn an honest living by his own exertions after he had once held the "king's commission." No such law prevails in this country, and the practice founded on it is an exotic ill adapted to the climate of a republic. We have now on the "retired list" of the army one general, four major-generals, twenty-six brigadier-generals, eighty-five colonels, and three hundred and fifty-nine officers of lower grade. The navy can make a like showing, and the civil

service is rapidly growing to the same proportions. Many of those "retired" officers have been placed on the list by the arbitrary favoritism of Congress, and some of them never held the rank in the army which they hold on the retired list. In fact, one of the chief abuses of political power is the reckless and irresponsible usurpation by which members of Congress confederate and combine to place their friends on the retired list, and their constituents on the pension-roll.

One of the amiabilities of the practice is its freedom from partisan bigotry. It is notorious that on a recent occasion the widow of an eminent Republican politician was rewarded with a pension of two thousand dollars a year, on condition that the widow of an eminent Democratic politician should be included in the bill and rewarded with a pension of the same amount. This having been done, the Republicans voted for the Democratic pension and the Democrats for the Republican pension. In this way the benevolence was lifted up out of the impure air of partisan politics into the ethereal atmosphere of good feeling and high life.

In one of Irwin Russell's negro hymns, the jingle sounds like this:

"Close up—saints in de center;
Fall in—sinnahs on de flanks;
An' all 'll get a pension an' a honorable mention
What stand up stiddy in de ranks."

We extend the principle far beyond those boundaries and give pensions to claimants, whether they stood up steady in the ranks or not. If the pension list could be analyzed it would be found that, after taking out the wounded men, fifty per cent of the others did not stand up steady in the ranks nor do any valuable service. It would be found that their diseases are pension pretexts only, and, where they really exist, that they were not contracted in the army.

In addition to pensions for all, we have supplemented claims for "equalization of bounties," and schemes of that kind. A Congressman from Iowa introduced a bill to give the soldiers the difference between the value of the greenbacks in which they were paid and gold at the time of payment. The statesman who introduced this bill is not at all troubled about where the money is to come from to effect its purpose. He is a descendant of Marryat's old sea-captain, who bequeathed princely sums to his friends, together with gold snuff-boxes and diamond-hilted swords which had been presented to him by various emperors and kings. As he did not own a dollar in the world, and the swords and snuff-boxes had no existence, the good-natured impostor showed his liberality without subjecting his will to the dangers of a contest. The sum of money necessary to pay that difference would be the

measure of a conquest, the ransom of an empire. It would far exceed the fine imposed by Germany on France in 1871.

It is time that the soldiers themselves repudiate the demagogues and vindicate their own patriotism. The glory of the Union army is tarnished by the mercenary clamor for pensions. If the soldier is to be a chronic menace to industry, he will forfeit his claim to honor, and cancel the obligation due him for service in the war. As it stands now, every Union soldier is "a suspect" in the eyes of his countrymen. He is regarded as a pension-grabber, and as a patriot who desires to commute his military glory for a stipulated sum in cash. The suspicion is unjust. There are thousands of Union soldiers who, having served the country in war, refuse to forage on it now.

It may be said, Why do they not protest against the pension scheme? Why do they remain silent while the forays are being organized? The answer is easy. In the first place it is not a pleasant thing for any old soldier to criticise the plans and purposes of his comrades. It is an unthankful duty, even if it is a duty at all. It can only make him unpopular among those whose approbation he would like to have. Secondly, he thinks that a general pension law is the only plan by which the worthy soldiers can be placed on a level of reward with the unworthy claimants who never did any good service, but who have no delicacy and no scruples about getting on the pension-rolls. He says: "There are many brave, needy, and deserving soldiers who will never make application for a pension, therefore let the Government offer it." And, thirdly, whatever his own opinions may be as to the morality or policy of pensions, he does not care to be officious in opposition to the general sentiment on that subject, nor does he wish to stand as an obstacle in the pension path of others.

During the latter part of the war there may have been some Union soldiers who were tempted into the army by large bounties, but they were a very small proportion of the whole. Excepting these, it may be truly said that the men who saved the Union neither knew nor cared when they enlisted what were the rates of pay, or the measure of allowances for service. They were moved by patriotism and not by promises of pay. The charge that they were a "mercenary soldiery" was false in the days of Abraham Lincoln, although it was freely made by the envious and disloyal. Let it not become true now. Let not the "pension temptation" change the character or diminish the fame of the Grand Army.

THE OLD AND THE NEW PHRENOLOGY.

By Prof. M. ALLEN STARR, M. D., Ph. D.

ALMOST every one has at some time wondered whether there is any truth in phrenology. The figures of heads, on which various mental faculties are marked, are to be seen everywhere, and the notion that from the shape of the head the character can be determined has enough of the mysterious in it to prove attractive. The thought that some one may discover our little foibles and more serious deficiencies—for it is these rather than our strong points that we are afraid of having found out—makes the study of bumps disagreeably interesting. And perhaps the desire to find out a little more about our friends than they would wish us to know adds somewhat to its attraction.

It is pretty well agreed among scientists, at present, that the old system of phrenology has no actual basis of fact, and that elevations upon the skull do not indicate masses of brain beneath them. But to this old system of Gall modern science really owes a great deal; for, like every false idea, it had within it a little kernel of truth, and the interest excited by the claims of its supporters awakened a discussion which has led to a discovery of the greatest importance in the saving of human life.

The claims of Gall that each part of the brain presided over some mental faculty stimulated Flourens, the leading French physiologist of forty years ago, to a series of experiments which seemed to show the falsity of Gall's hypothesis. These experiments in turn were disputed and led to others, and thus interest in the brain and its action was stimulated, until in 1870 the subject was taken up in Germany, and facts were discovered which form the basis of our present knowledge of brain action.

For in Germany a method of testing the action of the brain was invented by Fritsch and Hitzig in 1870. These men noticed that when they applied an electric shock to the brain of an anæsthetized dog, the result was a movement of the limbs. To cause this movement a certain part of the brain had to be irritated by the electricity, other parts being irresponsive; and it was even possible to distinguish the part which moved the fore-leg from that which moved the hind-leg, while, queerly enough, the irritation of one side of the brain always caused movements in the other side of the body. This was an important discovery, for it showed that one part of the brain governed motions while the other parts had nothing to do with motion.

The German investigators went a step further. They said, "If this part of the brain really governs motion, then when it is

removed the dog will lose the power of movement," and this reasoning was found in fact to be correct; for when this part, which they named "the motor area," was taken away, the animal was found to be paralyzed, while removal of other parts had no such effect. These experiments, since that time repeated in every laboratory of Europe and America, and tried upon various animals, have established the fact that there is in the brain a certain part which directs voluntary movements.

The second step toward the new phrenology was taken in England in 1873 by David Ferrier. Reasoning from the fact that our movements are usually the result of some preceding sensation, he concluded that sensation as well as motion must be governed by the brain. If motion is governed by one part, sensation may be received in another part. This reasoning led him to undertake a series of experiments to settle the question. He soon succeeded in showing that sensations, which are received by the various sense organs of our bodies—by the eye, ear, nose, mouth, or by the skin—are all sent inward to the brain, and that each of these organs sends its impressions to a distinct region of the brain; sensations of light going in one direction, those of sound in another, and so forth.

The work of Munk, of Berlin, in 1881, confirmed and added to the discoveries of Ferrier, and finally established the conclusion that sensations as well as motion can be located. So that to-day it is possible to lay out a sort of map on the brain of animals, and to say that each of the regions put down on the map has a particular sense with which it is related. On such a map there are here and there empty spaces, such as there are on our geographical maps of Africa—for no one knows what is there. But that, of course, does not invalidate our knowledge of regions which are known, and only shows that further discovery is possible. When we come to see the practical results of these discoveries, the arguments of those who oppose vivisection will cease to interest or move us.

These physiological experiments, however, are only of importance to us in our study of our own mental action, provided they have a bearing upon the working of the brain in man. And this is a question which has only been settled within the past fifteen years. It was admitted, indeed, that in the structure and appearance of his brain man resembled quite closely the higher types of gorilla and ape, and yet the apparently impassable barrier between men and animals as regards mental activity prevented any hasty conclusion that these facts could be applied to men. The question whether sensation and motion could be assigned to parts of the brain in the human race was still (ten years ago) an open one. Of course, it is impossible to experiment upon the human brain. But on a little consideration it soon became evident that Nature

was really furnishing the observer with a series of natural experiments on man in the form of disease. The physiologist removed a piece of the brain and watched the loss of sight or hearing, or the loss of motion which ensued. The physician, on the other hand, watches the same kind of loss of sight and hearing, or of motion, in his patient, and may perhaps conclude that here too a loss of brain-tissue is the cause. And this conclusion was confirmed by further observation. Perhaps this may be made a little clearer if we add a fact or two regarding the way in which these experiments of nature are conducted. The blood which is sent to the brain at every throb of the heart goes up in a set of tubes, which give off side branches, like the system of water-pipes which connect your basins with the reservoir. Each tube gets smaller as its branches are given off, until at the end, instead of one large pipe, there is an innumerable series of little end pipes, each throwout its little stream.

Let us picture to ourselves the water-pipe system of a town set up on a frame aboveground, with the great main, the street mains, the house pipes, and the little pipes all over the houses, all in view, and we will have a sort of conception of the brain's vessels and its blood-supply. Now, it is easy to see that, if a stick or a mass of leaves start out from the reservoir into a main, they will go on and on till they reach a pipe too small to allow them to pass, and there they will lodge. If the stick gets into one's house pipe, one's entire house will be cut off from the water-supply; if the mass of leaves breaks up, a few particles may come in and plug up a pipe to one only of the basins. But in either case the basin will be as useless for washing purposes as if there were no reservoir at all. Now, something very similar to this occurs in disease. Little plugs sometimes come up to the brain from the heart in the blood, and lodge in the little vessels which conduct the blood to various parts of the brain; and when the part of the brain is thus cut off from its supply of nutrition, it gradually withers up and ceases to act.

But when it ceases to act, a loss of some one sense results, just as in the dog when a part of the brain was cut out a loss of some sense occurred. When these facts were studied in this way, it soon became evident that in some persons it was the sight, in others the hearing, in others some other sense, in others still the power of movement which was lost; and further study showed that the varying effect depended upon which part of the brain was deprived of nutrition and was withered, just as in the dogs the location of the part removed determined which sensation was destroyed; so that a striking parallel between the results of experiment and the results of disease can be drawn; and thus the conclusion is arrived at that what is true of animals *is* true of man, that in man as well as in

animals certain regions of the brain can be mapped out and can be assigned to the different senses. It has thus been proved that in their *action* as well as in their *structure* the brains of man and of animals are alike.

If in structure and in function all brains are somewhat similar, it may be interesting to obtain a little notion of what a brain is really like. The figure will demonstrate this very well.

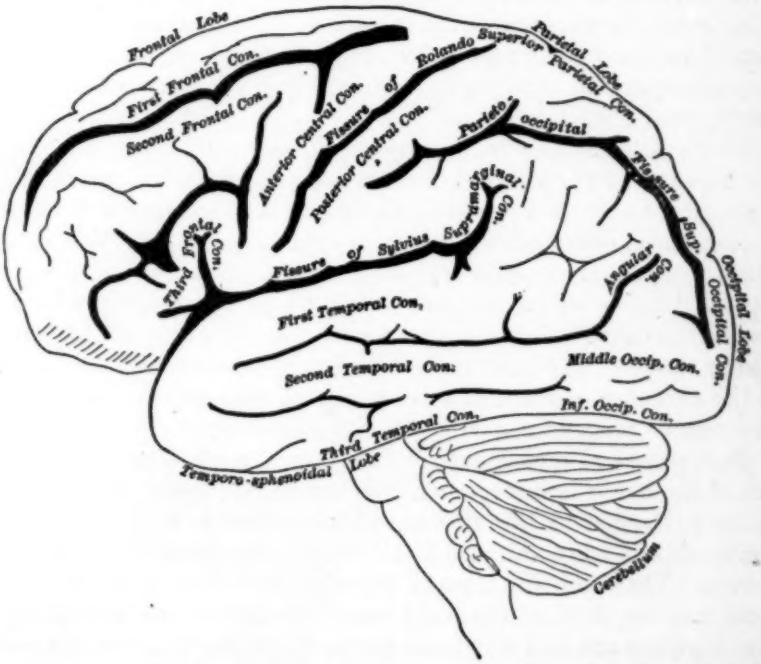

FIG. 1.—DIAGRAM OF THE EXTERNAL SURFACE OF THE LEFT CEREBRAL HEMISPHERE (modified from Ecker).

It shows that the brain is an egg-shaped organ with an irregular surface of a yellowish-gray color. The irregularities are formed by a folding of the surface layer so as to accommodate itself to the small space in the head. To illustrate this, when a handkerchief is spread out over the hands it takes up a great space, and a box in order to hold it would have to be of large size; but by gathering the handkerchief up in the hands it is thrown into folds, and, although its actual surface is not decreased, the space it occupies is much diminished, and it could now be put in a very small box and yet all be there, but then its surface would be irregular and show many creases. Now, what was done to the handkerchief Nature has done to the brain as it has developed. In the lower animals and in an early stage of life the folds are few and simple, but in man when full grown they are many and complex. This only means that the actual surface of

the brain if spread out would be much greater in man than in the lower animals, and far too great to be laid out flat within the head. There are many interesting facts which make one believe that the greater the extent of brain surface in a man, or, to put it a little differently, the more the folds and deeper the creases between them, the greater are the man's mental powers; and just here it becomes apparent that to judge of the extent of the entire brain surface by the size of the head, or by the extent of the superficial irregular surface which is covered by the skull without any regard to the number of folds or their depth, is to fall into an absurd error, and here we begin to see how baseless the old phrenology really is.

For a little brain with many deep folds may really when spread out have a larger surface than a large brain with few shallow folds, and a so-called bump or elevation on the apparent surface of the organ, even if it produces a corresponding elevation on the head, which it frequently fails to do, will indicate nothing regarding the number of the folds or the depth of the creases which lie about it, so that it may be stated without hesitation that from the size or shape of the head no conclusion whatever can be made as to the extent of surface of the brain, and consequently no conclusion can be reached regarding the mental capacity.

But what lies underneath the brain surface? The inner structure of the brain is interesting. Everywhere coming off from the under surface are white threads which gather into bands and pass downward and inward, and finally come out below in the form of nerves. These are the lines of communication by which messages from various parts of the body reach the brain, and along which the impulses are sent out from the brain to the body which result in speech and action. Imagine for a moment that from every part of your hand little threads pass up the arm and find their way to the brain, and there go to a special part of its surface and end. It can be seen at once that you would have a little map of the hand laid out on the brain surface, projected there, to use the terms of the geographer; and in fact such a map of the entire body could really be drawn on the brain surface if we could follow all the little threads to their ends. A sensation which has been sent in from your little finger has always gone to a definite place in your brain, and whenever a message passes along that thread and goes to the brain you feel a sensation in the little finger. The thread goes along your funny-bone at the elbow, and if you happen to strike it there you send a message along it to the brain; but as all such messages have usually come from the little finger, the brain supposes that this one has also come from there, and that is the reason that, although you strike your funny-bone, you feel it in the finger. That also is the reason why peo-

ple whose fingers have been cut off often say that they have pain in the missing finger, and when you are seated on a hard or uncomfortable chair your foot "goes to sleep."

Now, just as the fingers are joined to the brain we must believe that the other organs are joined to it. Thus the eye sends in its thousands of little threads to one part of the brain surface, the ear to another, the nose and tongue to another. So that each of

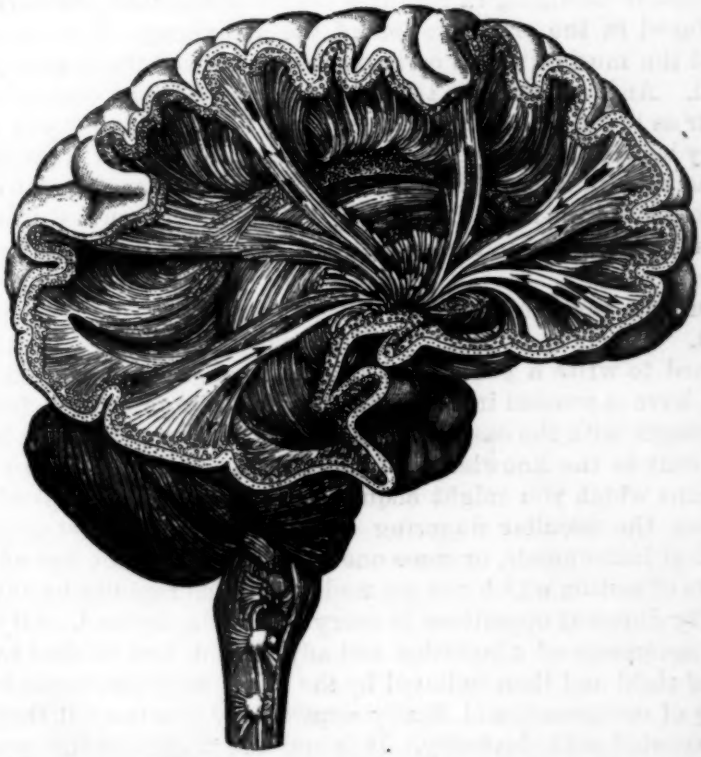

FIG. 2.—DIAGRAMMATIC REPRESENTATION OF THE DIRECTION OF SOME OF THE FIBERS IN THE CEREBRUM (Le Bon). The foldings of the surface; the association fibers joining different regions of the surface with each other; and the fibers passing down to the organs of sense are shown.

the organs of sense is related to a special region of the brain. And each of these regions receives messages from its own particular organ and from no other. That is what is meant by the term localization of brain functions; namely, that each power of sensation can be assigned to a location of its own. This idea aids very materially our conception of the senses. The sense of sight, for example, can not be thought of as dependent upon the eye alone, but upon the eye and the visual part of the brain surface with their connecting threads. And, after all, we must admit that we do not really see with our eyes or hear with our ears. Why does your friend want to hurry through an art gallery, while you wish

to look carefully at the paintings? You both see them with your eyes alike. Is it not because behind the eye there is something that is mental which enhances your enjoyment, and the lack of which prevents him from appreciating the beauties of art?

Go to a concert, and, as you come away, listen to the comments of people about you. One says that he was occupied chiefly in watching the gyrations of the man who plays the kettle-drums. Another is indulging in raptures over the intricate counterpoint displayed in the orchestration of the symphony. You have enjoyed the music without perhaps having noticed the counterpoint at all. And yet you and the other two have heard equally well, so far as the actual hearing goes. But how differently you have really heard! It has been the reception of the sounds in the brain, rather than in the ear, the appreciation of their meaning, the ideas awakened by the sensations there, which has determined this difference. You see and hear with the brain, and not with the eye or ear.

Or take another function of the brain, that of voluntary movement. You may be fairly skillful and graceful; you may have learned to write a good hand, or to play on the piano; you may even have succeeded in acquiring the power to pronounce foreign languages with the ease and fluency of your own. But this is not the limit to the knowledge of movement. There are many new motions which you might acquire; for example, the steps of new dances, the peculiar fingering of the violin or cornet or other musical instruments, or some one of the innumerable fine adjustments of motion which you see made with such rapidity by any one of fifty different operatives in every factory in the land. All these are movements of adaptation and adjustment, first studied by the aid of sight and then imitated by the aid of muscular sense, or the sense of movement, and finally acquired by practice till they can be executed with dexterity. It is not the fingers or the muscles which have learned the movements. It is the brain which, in its motor area, has received the sensation of movement, has retained a memory, and then combined the memories into new forms of motion so as to direct and guide the hand which carries them out. And so, though we all have hands and arms, there are some who use them deftly and are skillful, and there are others who will always be hopelessly clumsy and awkward. And the difference lies in the brain in the part called the motor area.

Where are the various areas? They can be shown by the aid of diagrams representing the brain surface (Figs. 3 and 4). In the middle lies the motor area (Fig. 3, 1), and it is interesting to know that on the left half of the brain, which guides the right hand, it is larger in extent than on the other side which controls the left hand; because the majority of fine movements are performed by

the right hand, and have to be learned by the left brain. The reverse is true of left-handed people.

At the extreme back is the visual area which receives impressions from the eye (Fig. 3, 2; Fig. 4, 2). In the lower part of the side the auditory area is situated, where impressions from the ear are received (Fig. 3, 3). On the under surface and in front of the auditory, the senses of taste and smell are located (Figs. 3 and 4, 4). Touch, which includes the senses of location and of movement, as well as those of temperature and pain, is assigned to the same area as that of motion, but extends a little farther back (Figs. 3 and 4, 5), and this overlapping of the two is not strange when we consider that our motions are guided by touch; think how differently you lift a heavy lamp or a fine bit of cotton-wool, and you will see how your grasp is guided by touch. These are the areas which are thus far discovered, but our knowledge of the brain is by no means complete, for there are large regions, on this African map, of undiscovered country. Fortunately, several Stanleys are on the way.

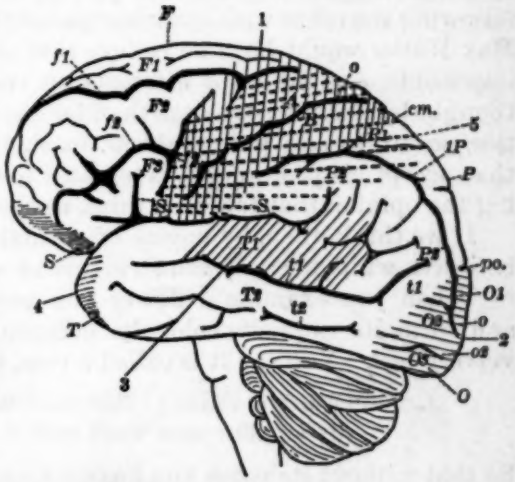

FIG. 3.—THE FUNCTIONAL AREAS ON THE BRAIN SURFACE. The parallel lines show the situation of different areas: 1, area of motion; 2, area of sight; 3, area of hearing; 4, area of smell and taste; 5, area of touch.

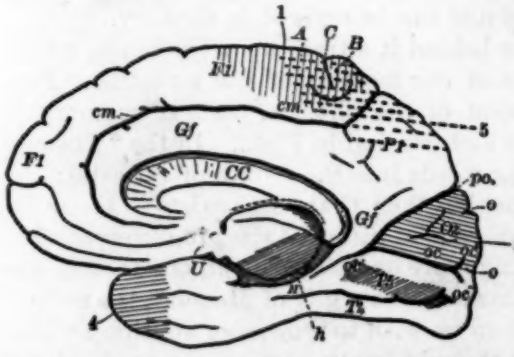

FIG. 4.—THE MEDIAN SURFACE OF THE RIGHT HALF OF THE BRAIN, SHOWING FUNCTIONAL AREAS.

Let us now, accepting this theory of the localization of functions in the brain, go on to see how much it reveals to us regarding the process of thinking.

Although a part of our thinking is done by the aid of language, the greater part of it is carried on without the consciousness of actual words. Mental images are constantly passing

through the mind, one crowding upon another; and it is only when we need to tell some one else about them that we use language. Call up to your mind for a moment the place in which you passed last summer, and already there has appeared a series of mental images of place and people, of scenes and events, each following the other with amazing rapidity but in silent succession. Max Müller would have us believe that thought without words is impossible, and he even attempts to trace the development of thought by studying the growth of language.* But many authorities, scientific and philosophical, teach the contrary, and rather than accept his position one is tempted to undermine it by advancing the opinion that few men think as the student of words does.

If we think, then, by means of mental images largely, it may be worth while to study the structure of a mental image.

When you examine a flower you perceive its graceful shape and form, its exquisite color, its delicate fragrance, and its soft, velvety feel. You say it is called a rose, but—

> "What's in a name? That which we call a rose,
> By any other name would smell as sweet."

So that without its name you have a mental image of it, which is made up of several distinct sensations. These are the sensations of the rose as it appears to the eye—*the visual image;* the sensation as it reaches the nose—*the olfactory image;* and the sensation of its touch, its shape, and softness—*the tactile image.* These impressions on the different senses have been sent to distinct and separate regions of the brain surface. There, having been received, they are stored up, so that the image once formed can be recognized when repeated and can be revived in memory.

Every sensation leaves behind it a trace upon the brain, which trace is the physical basis of our memory of the sensation. Perhaps no modern conception of the physical basis of memory is more graphic than that which we find in Plato. In the "Theætetus" he puts the following words into the mouth of Socrates:

"I would have you imagine, then, that there exists in the mind of man a block of wax, which is of different sizes in different men, harder, moister, and having more or less purity in one than in another. Let us say that this tablet is a gift of Memory, the mother of the Muses, and that when we wish to remember anything which we have seen or heard or thought in our own minds, we hold the wax to the perceptions and thoughts, and in that receive the impressions of them as from the seal of a ring; and that we remember and know what is imprinted as long as the image lasts; but when the image is effaced or can not be taken then we forget and do not know." †

* "Science of Thought." † "Theætetus," Jowett's translation.

Plato carries out the same figure to explain different degrees of memory. When the wax is deep, abundant, smooth, and of the right quality, the impressions are lasting. Such minds learn easily, retain easily, and are not liable to confusion. But, on the other hand, when the wax is very soft, one learns easily but forgets as easily; if the wax is hard, one learns with difficulty, but what is learned is retained.*

In some way or other, we do not know exactly how, the sensations leave behind them impressions or memory pictures.

And these separate memory pictures are associated together, as they have all come from the same object; so that, the association being once made, any one will bring to mind the others, and hence if you perceive the fragrance you remember the appearance of the flower from which it comes—its color or its feel. This association of separate memory-pictures is secured by means of fine nerve-threads, which pass between the various areas of the brain and join the parts of the mental image with each other. This may be represented in the diagram (Fig. 5) by placing a circle for each memory-picture in its appropriate place and joining the circles by lines. The circles represent those little round masses of brain substance called nerve-cells, and the lines the association nerve-fibers uniting the cells (Fig. 6). The diagram shows the physical basis of the mental image of a rose—what has been called by Romanes a "recept," since its elements have been received by the senses.† What is true of the rose is true of every other object which we have ever learned to know, for of every object we have a recept, or a series of mental images in the brain.

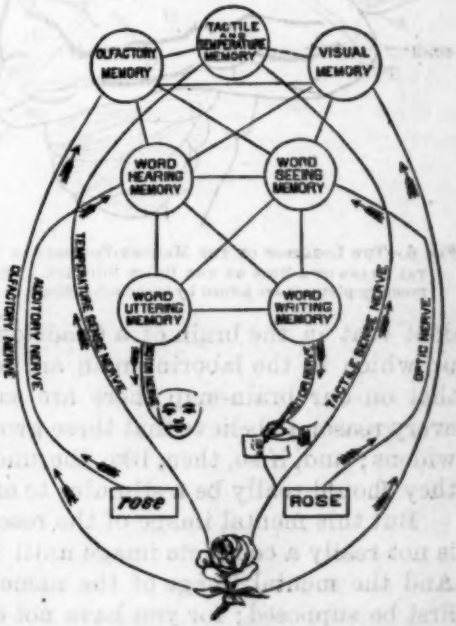

FIG. 5.—DIAGRAM TO ILLUSTRATE THE CONCEPT ROSE.

Each memory is the relic of a past perception, acquired through an organ of sense. These memories are associated, forming together the concept.

The lines from the rose represent the channels of sensation; the lines between the circles the association tracks. The mouth and hand are the motor organs of speech and writing.

* "Memory Historically Considered," Burnham, "American Journal of Psychology," ii, 41.

† Romanes, "Mental Evolution in Man," p. 86, D. Appleton & Co., 1889.

We are constantly increasing our store of mental images, and when one contrasts the small number of such images in the brain of a common uneducated day-laborer with the myriads in the brain of one who has traveled widely, has become familiar with the stores of information in foreign languages as well as in his own, and has cultivated his powers of observation in many different directions—for example, such a great leader of thought as Gladstone—one can not but be amazed at the capacity of work in this little organ, the brain. And if there is a physical basis for each of these mental images, is it not evident that in the brain of a Gladstone large areas must be taken up which in the laboring man are really empty? We have seen that on our brain-map there are some empty spaces. There is every reason to believe that these grow smaller as our information widens; and, if so, then, like the undiscovered country of Africa, they should really be a stimulus to efforts of further conquest.

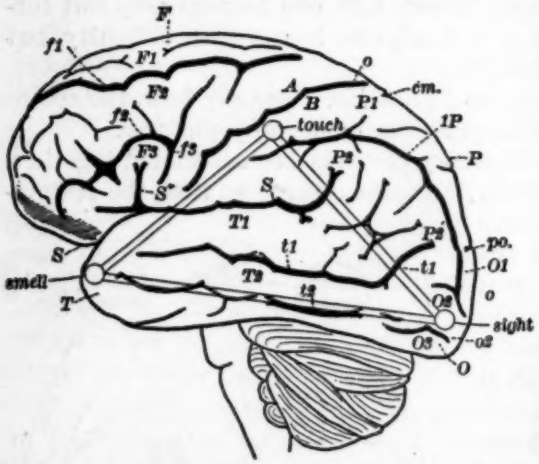

FIG. 6.—THE LOCATION OF THE MEMORY-PICTURES IN THE MENTAL IMAGE OF A ROSE ON THE BRAIN SURFACE. The different memory-pictures are joined by association fibers.

But this mental image of the rose, as represented in the figure, is not really a complete image until it is associated with a name. And the mental image of the name is not as simple as might at first be supposed; for you have not only learned to recognize the word "rose" when you hear it, or when you see it printed, but you have also learned to say the word and to write it, so that you really have a *word-image "rose"* made up of two sensory images, auditory and visual, and of two motor images, or the memory of the effort necessary to use the word in speech and in script. It is necessary to add then four more circles to the diagram to show the physical basis of the word "rose," and each of these must be placed in its own special region, which has been determined by a long series of investigations. These circles, too, must be joined together, since all the parts of the word are connected in the mind; and, finally, the word-image and the mental image, in all their parts, must also be associated (Fig. 7). Thus the complete mental image of such a simple object as a rose is made up of numerous distinct mental pictures, each joined to all the others, and each located in

its own particular domicile. Now, such a mental image is termed a *concept*, and concepts are the material of thought. Thought is the play of consciousness among these concepts—a play which always, in our waking hours, is within definite boundaries and along lines of association. The oddity of our dreams arises from the disregard of these lines and boundaries in a semi-conscious state. Many of the concepts are related to one another. Thus the rose is only one of many flowers which you know, and the term "flower" really brings to a focus all the images of the different roses, chrysanthemums, pansies, and pinks and varied objects which the most complete horticultural exhibition can display. The term "flower"—which we may call an abstract term, because it stands, not for a single object, but for a class of different objects with common features—enables us to handle these many mental images easily and communicate the pictures before our minds to others. It is a convenience, then, to use the word; but, nevertheless, it is the mental images, rather than the words, which play the greater part in our thinking.

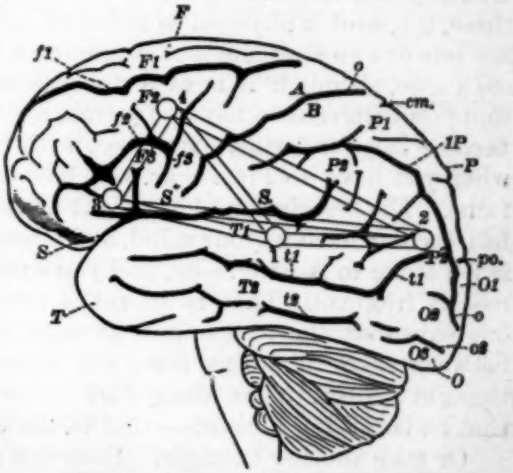

FIG. 7.—THE LOCATION OF THE MEMORY-PICTURES OF THE WORD-IMAGE ROSE. 1, word-hearing; 2, word-seeing; 3, word-uttering; 4, word-writing memory-picture.

This has been most ably expressed by the Duke of Argyll, who says: "Images are repetitions of sensation, endowed with all its mental wealth, and consciously reproduced from the stores of memory. Without images we can do nothing in the fields of thought, while with images we can mentally do all things which it is given us to do. The very highest and most abstract concepts are seen and handled by our intellects in the form of voiceless imagery. How many are the concepts roused in us by the forms and by the remembered images of the human countenance! Love and goodness, purity and truth, benevolence and devotion, firmness and justice, authority and command—these are a few, and a few only, of the abstract ideas which may be presented and represented to us in every degree and in every combination by the remembered image of some silent face. What a wealth of concepts is set before us, for example, in the images raised by this single line:

'Her eyes are homes of silent prayer'!

"Introspection will convince us—perhaps to our own astonishment—how large a part of our thinking operations are conducted through the raising and recalling of remembered images." *

But it may be objected that one can not spend one's time in day-dreams, or in the mere pleasures of memory and imagination. You say that reason and action are the real things of life. Have these, too, such a physical as well as a mental basis? Let us follow one or two simple acts of reasoning for a moment. When you see a rose, although it is at a distance from you, you will admit that you believe it to have a fragrance. You conclude that it has, because in your former experience with roses you remember that, when you have held one near, you have always perceived its perfume. The association of the sight of the rose and the fragrance has become fixed in your mind, and when you see it your thought is led along to its fragrance, and you draw the conclusion that the rose is fragrant. That is an act of reasoning. Supposing some one says that the rose sounds sweetly. You have no association between such things as roses and sounds in nature, and your thought refuses to run along where there is no track. You reply that he is talking nonsense—that is, the unreasonable.

Or take another example. Your dog sees you go into the hall and take up your hat and cane; he at once jumps up and runs about, showing by his action that he has come to the conclusion that you are off for a walk, and that he wants to go with you. What is the basis of this process of reasoning? He has a mental image of this act of yours, associated with another mental image of a run on the lawn, and the first calls up to his mind the second. In his experience one act has usually followed the other, and he draws the conclusion that you are going out where he can run. You say at once that the dog has reasoned correctly. It may even be true that the dog has learned to understand language. Many dogs know the word "out," and it calls up to them as distinct a mental image as your act of putting on your hat. Sir John Lubbock has even taught his dog to read; † for, by showing him a large card on which the word "water" was printed, every time he gave him a drink, an association was established in the dog's mind between the card and the act; and, finally, when the dog wanted a drink, he would bring the card in his mouth to his master. Ten such different words were taught him, and he rarely made a mistake. So that the understanding of speech and of writing and the act of reasoning, so far as simple conclusions go, from the recollection of mental images, may be granted to animals as well as to man. And these acts of reasoning, like those

* Argyll, "The Identity of Thought and Language," "Contemporary Review," December, 1888, p. 814.

† "Intelligence of Animals," D. Appleton & Co.

of memory, have as a basis the association of ideas. It may be admitted at once that many high processes of thought involve the following of association along many lines at once, or in such a complex way that to picture them clearly to the mind would be an almost impossible task. But there appears to be no essential difference in kind between the simple conclusions which have been used as illustrations and the more complex ones involved in abstract reasoning. The logician will reduce all your acts of reasoning to certain syllogisms which it is now quite customary to express in algebraic formulæ. For each of these formulæ it is possible to picture a physical basis of nerve-cells, joined together by nerve-fibers, so that it seems probable that the mechanism of thought will some day be understood. Our thoughts are usually so rapid and so many that we do not stop to analyze them, but, when we do, we find them always the result of a gradual accretion of ideas and not a new creation. The inventor will tell you that his mostbrilliant discovery did not spring suddenly into his mind in all its perfection, but was gradually led up to, step by step, with many halts and puzzling alternatives. Finally, old mechanisms and principles, formerly familiar, were successfully associated together with new adaptations into a new unit, and the ingenious mechanism was complete. The evolution of the locomotive, of the telegraph, and of the telephone teaches us the process in the inventor's mind as clearly as it shows his genius for construction. There are many other mental processes which might be followed out which display equally well how closely reasoning depends on the association of ideas—i. e., upon the play of consciousness along lines of communication between different regions of the brain. But we must pass on to some illustrations of action.

Watch a game of tennis and notice the difference between players, and you can tell a great deal about their mental processes. One is quick to see the ball, to note its direction, and to calculate its speed and the position it will reach in a moment, and yet from a lack of quickness in movement or from clumsiness he is unable to return it well. Another is particularly agile and graceful, plays all over the field, and seems to be everywhere at the right time; and you think him the better player. But as you watch you find that he judges the ball badly, and is not accurate in his calculation as to where it is going or when it will fall. The champion player is the one who combines accuracy and quickness with precision and agility. The sight of the direction of the ball leads him at once to a correct judgment of how far he has to run or reach for it, and his movement is quick enough and directed with just sufficient force to make the return. Now, this matter of precision of movement is dependent upon a process of perception,

association, and effort, and is to a great extent a matter of inborn capacity. The physicists express this by saying that each of us has his personal equation. Perhaps this will be more easily understood if we follow the manner in which it was discovered. One of the interesting astronomical events is the eclipse of Jupiter's moons as they pass behind the planet and disappear from the astronomer's view. Maskelyne, British astronomer royal, and his assistant in the Greenwich Observatory, in 1795, sitting side by side and looking through two telescopes, were attempting to record very accurately the moment at which the eclipse was complete. It was found that their records differed from one another by some fractions of a second. And the differences were about the same when other observations with a similar object were made. The explanation of these differences has been found, after many years of investigation, to be due to a difference in the rapidity with which each man observed and recorded his observation, and those differences can now be measured. This was not appreciated at first, for we find that the result of this discovery of a difference between the records of the two observers was very unfortunate to one of them; for in his annual report Maskelyne writes:

"I think it necessary to mention that my assistant, Mr. David Kinnebrook, who had observed the transits of stars and planets very well in agreement with me all the year 1794, and for the great part of the present year, began from the beginning of August last to set them down half a second of time later than he should do according to my observations; and in January of the succeeding year, 1796, he increased his error to eight tenths of a second. As he had unfortunately continued a considerable time in this error before I noticed it, and did not seem to me likely ever to get over it and return to the right method of observing, therefore, though with reluctance, as he was a diligent and useful assistant to me in other respects, I parted with him."

Thus Mr. David Kinnebrook fell a victim to the earliest discovery of the difference of power of observation.

How these differences were measured it would take too long to relate. The results only can be stated, and for details reference made to an article by Prof. Cattell in a recent number of "The Popular Science Monthly" on "The Time it takes to Think," and to one by Prof. Sandford, in the "American Journal of Psychology," on the "Personal Equation." *

Any act which depends upon sensation, such as returning a tennis-ball or replying to a question, takes time. This act can be separated into certain parts. There is the perception of the sensation, the decision to respond to it, and the act of motion. You

* Vol. ii, No. 1.

hear the question, you think of the answer, and you say it. Each of them has been separately measured, and takes from one tenth to one sixth of a second, so that the entire process requires from three tenths to one half of a second to complete it. People differ widely from one another in this rapidity of action, and the same person differs much at different times, and the explanation of this difference is found in the inherent power of activity in the brain. The effect of wine is to make these acts slower. The action as a whole calls into activity several parts of the brain, the nerve from the organ of sense to the brain, the part receiving the sensation, the tract from it to the motor area, and the part of that area which initiates the impulse and guides the movement and the nerve thence to the muscles. It is not surprising, therefore, that it should take some time; the astonishing thing is really the rapidity with which the brain acts, for modern measurements extend to thousandths of a second, and some mental processes in rapid brains take only a few hundredths of a second to be completed. Familiarity with a certain act lessens the time it requires. A lady was heard to say the other day, in alluding to the acting of the French comedians who have recently been seen here, that it was surprising how much faster French people talked than Americans. She would have thought it an act lacking in courtesy had it been insisted upon that it was not because they really talked faster, but because her English-speaking brain refused to think as rapidly in French, that had led her to the conclusion. Yet such was the fact.

There is one more process of mental activity to which allusion must be made, as it has thrown much light upon the theory of localization, and has now been fully explained by that theory—viz., the power of speech. There is perhaps no mental process which brings us more closely to the point of meeting of the physical and mental elements of the mind.

Language is so complex, as we survey it and as we constantly use it, that it seems at first impossible to unravel all its mysteries. But, if we watch its growth, we can get at some facts of not a little interest. Let us trace the way in which a baby learns its first word.* As the baby looks about him he begins after a time to distinguish faces, and one face, his mother's, being constantly near, soon becomes most familiar. Mothers are constantly talking to their babies, and always speak of themselves as "mamma" or "mother," never using "I" or "me." After a time the baby begins to notice this sound "mamma" and to recognize it, and then the fact that a certain face and a certain sound usually come together finally establishes a fixed association between the sight-picture and the sound-picture, so that the one when brought to mind brings up the other. Then, if you ask the baby, "Where

* Preyer, "The Mind of the Child," D. Appleton & Co., 1888.

is mamma?" he will look about the room until he finds the familiar face. He has now taken his first step in acquiring speech, he has learned the meaning of a word. The second step follows after a time. From time immemorial in the baby's experience he has been able to cry, and he knows it; in other words, he is aware of the fact that it is one of his native powers to make a noise. By and by it begins to occur to him that this sound, "mamma," is also a noise, and some day, probably by accident, as he is being cruelly shaken up by being trotted on some one's knee, he emits a sound like "mamma." If he is a bright baby—and whose baby is not?—he notices the similarity between the sound he has made and the sound he has already learned. Such attempts at saying "mamma" usually meet with considerable active encouragement of an agreeable kind, and he naturally repeats the attempt. After many failures it is a success, and he has at last acquired a memory of the exact effort in certain muscles of lips and tongue needed to produce the sound, and has also associated that memory of effort with the memory of the sound which in time is joined to the memory of the mother's face. And now the second process is complete, and the baby knows how to say the word intelligently; for intelligent speech is speech based upon an association of ideas. Of course, as the child grows, he subsequently adds a visual picture of the word "mamma" to the auditory picture when he learns to read; and a manual-effort memory to the speech-effort memory when he learns to write. When all these four memories are acquired and associated, he has acquired the use of language.

Now, what is true of this simple word has been true of every other word which we make use of; and, though we can not recall this process which we have been through, we can see it going on about us. If you wish to study it carefully, study children, by the aid of Preyer's interesting book, "The Mind of the Child."* Or if you wish to observe the process more directly, recall the manner in which you have acquired a foreign language, for that is done in the same way, if the natural method is followed. Suppose that you are told that in German the brain is called Gehirn—that it is pronounced gayheern, and spelled g-e-h-i-r-n. If you are not familiar with German, you have now a new word-image connected with the mental image of the brain much more easily acquired than was the word "mamma" when you learned it, but nevertheless acquired in the same way.

Whether we think, then, in mental images or in language, the process is the same; it is consciousness playing along certain lines of association to and fro between definite memory-pictures. These memory-pictures have been acquired through the senses,

* The practical application of this knowledge is made by Dr. Mary Putnam Jacobi, in an article on "Language in Education," "American Journal of Psychology," vol. ii, No. 1.

each through its own particular channel of sensation, and are stored up in the brain, each in its particular part of the brain.

Memory is the revival in consciousness of these various memory-pictures.

Imagination is the combination of old pictures into a new image.

Reasoning is the passage of thought from one picture to another, along established lines.

Action is the carrying out of the impulse to whose memory reason has led up.

These are some of the mental faculties, and it is at once evident that they are not distinct entities, like the mental image, but rather powers of the mind to deal with these images; and, therefore, the faculties can not be said to have any particular seat, and can never be located in an area of the brain. Imagination and reasoning power are therefore not to be assigned to bumps on the head, as the old phrenology taught. And even when we speak of memory we distinguish it broadly from the memory-pictures, which do have a location, but one that is wholly different from that taught by Gall. Here, again, we see how far removed from the old phrenology the new phrenology is, and how much more exact in its knowledge. If proofs of these facts are demanded, they are to be found in the study of diseases of memory, as described in Ribot's entertaining little volume. But one or two statements may be made, very briefly, in closing, which must carry conviction to the most skeptical mind.

The reason why it is now accepted that each sense with its memory-pictures has a definite location in the brain distinct from all others, is that it is possible for one sense or one set of memory-pictures to be lost without affecting the others. There are men in apparently perfect health who have suddenly lost all their sight-memory, so that they no longer recognize people or things formerly familiar. One such man did not even know his wife until she spoke to him, when he at once knew her voice. There are men who have in the course of a few moments been deprived of their memory of language, and who, although they could talk and even write, were as incapable of understanding what was said to them or of understanding what they saw on a printed page as one would be of spoken or written Chinese. There are others still who have lost their artistic or musical powers, but in other respects are perfectly sound, so that instead of being able to sketch from memory as formerly they are unable to call up to mind a single memory-picture; and instead of being able to follow or recollect a melody or appreciate the harmonies of music, they are totally deprived of this pleasure, and this without any blindness or deafness excepting of the mind.

Others, again, lose the power of speech or of writing without having their understanding of language interfered with or without any paralysis of the muscles—the effort-memory of speech is lost.

Such effects find their only possible explanation in the fact that each set of memory-pictures may be destroyed simply, and this is only possible provided they are situated in separate regions of the brain.

And there is a great practical application of all this theory of localization, which has only been reached within the past three years.

If it is possible to locate a set of memories, and in the progress of disease those memories are lost, it is evident that the location of the disease has been determined. Sometimes that disease is of a kind which can be removed—for example, a brain tumor. From a study of such facts as those presented here it has been possible to determine the location of tumors in the brain, and, although externally there was no sign of disease, it has been possible for surgeons to go through the skull to find the tumor and to remove it. Up to the present time about seventy such operations have been done in this country and in Europe, and of these fifty have been successful, and what was formerly considered a necessarily fatal disease has thus been cured.

The practical demonstration of the truth of the new phrenology is therefore complete.

The old phrenology, as we have seen, was wrong in its theory, wrong in its facts, wrong in its interpretation of mental processes, and never led to the slightest practical result. The new phrenology is scientific in its methods, in its observations, and in its analysis, and is convincing in its conclusions. And who can now set a limit to the benefit it has brought to mankind by its practical application to the saving of human lives?

LIFE AT THE CAMEROONS.

By ROBERT MÜLLER, M. D.

THE Cameroons youth has the inclination to independence from the day of his birth, and it is taken advantage of by his mother. Before he can walk, she sets him out near the house, where he looks about him all the day at will. As soon as he is large enough she gives him the day's catch of fish of his father or elder brother, to spread and turn for drying and putting away. As soon as he can use his legs, he is taken by his brothers or a friendly youth in the canoe, and is gradually taught the management of the vessel. When he has become stronger, he is allowed

to go alone and disport himself in the water to his heart's content. At the same time he begins to fish, using four lines at once —two attached to his big toes as his feet hang over the side of the boat, and two held in his hands. It is a curious spectacle indeed to see him pulling in first one foot and then the other, as a fish has been caught upon it, and at the same time gesticulating with his arms to keep the boat in position and manage the lines in his hand. As he fishes the boat is allowed to drift down the stream; but the pulling back absorbs his entire attention. Crab-fishing comes in about every two years, when the crustaceans occupy the water so thickly that they can be caught as fast as they can be taken out with the hands.

For the chief dish at his breakfast or dinner he receives a hash of various vegetables, baked or packed sausage-fashion in leaves. Rice, bought from the factories, and pilot-bread from the ships, are becoming common, and are regarded as delicacies. A favorite dish is made of chicken and yams, cooked, with pepper-pods, in palm oil. The youth eats his meal in company with his mother and brothers and sisters, and is allowed only in exceptional cases to share his father's usually solitary repast. By "brothers and sisters" are understood only children of the same mother; the others are the sons and daughters of his father. I learned this when I asked my little companion Akuelle, a son of King Bell, who was the other youth with us. "He is a son of King Bell," was the reply. "Then he is your brother?" "No, doctor, he has another mother." When the child is nine years old he is shorn and counted among the men. If his father is rich, a wife is bought for him, but the couple are not expected to live together for some years yet. During his earlier years the negro of this part of Guinea is conspicuously intelligent and a most pleasing companion. But his good qualities disappear with the passing away of his youth, and he becomes the false, idle, quarrelsome African of the factories.

The breech-clout constitutes the usual clothing of the men. A small apron is also worn, so that if the former piece becomes oppressive it can be taken off without the man being wholly naked. Articles of European clothing are often worn, but only on the upper part of the body; trousers have not yet been admitted to the Cameroons wardrobe. King Bell wears also a stove-pipe hat, which he manages to keep always looking new.

The birth of a girl is received with great joy, as a costless acquisition of wealth, for she is sure when she becomes marriageable to bring a goodly sum. The purchaser may come from the same village or from another, but is more welcome in the latter case, for then he will have to pay more. The child grows up under the eyes of her mother, and is taught by her to cook, work

in the field, take care of the other children, and smoke. All this must be done early, for it will not be many years before a purchaser will come for her; and at ten or twelve years of age she will probably be called upon to follow a stranger. Notwithstanding the early marriages, the number of children seldom exceeds three, and the woman is a matron at twenty. When she has passed her bloom she is relegated to the capacity of a servant, and her husband gets another, younger wife. Thus men of means often take one or two new women every year. The women and their children live in separate houses, which are not shared by the husband. He lives, too, in a house of his own, in the midst of the women's houses, which are sometimes quite numerous. King Bell has a hundred and twenty wives. The intercourse between mother and child is very different from what it is with us, and the Cameroons mother is more sparing in her caresses than her white sisters. Kissing has no place among them, but they have their own peculiar ways of fondling and petting, which perhaps represent as much affection as the more demonstrative proceedings of Europeans.

So long as they are young and handsome the Cameroons women pay great attention to their toilet. The petticoat, which reaches down from the hips to the ankles, must be thoroughly smooth and clean, and the apron, which is worn under it, is as spotless as the under-clothing of a European lady. Their hair is woven by professional hair-dressers into braids of various shapes, without grease and usually without ornaments, although a woman is occasionally found who wears a string of beads around her head. The dressing usually lasts for a week, and is bound up at night in a cloth for protection. It is also a part of the hair-dresser's business, which is carried on in the street, to pull out the lady's eyelashes. A string of pearls or some other ornament of European origin is worn around the neck. The shoulders, breast, and belly are covered with ornamental tattooing in red and blue, apparently centering at the navel. Elaborate ruffles of ivory or metallic rings are worn upon the wrists and ankles.

The principal musical instrument is the drum, or *climbi*, which is made from a hollowed log. It has a slot along the direction of its length, which is unevenly divided by a bridge left across it, on which the drumstick is beat to produce different tones. The music is at first monotonous enough to the ear, and it is hard to realize that the instrument is available as a telegraph. Yet this is its principal use. The Cameroons man drums out every event that appears worth communicating. The next man takes it up and drums it on, and in this way news is spread speedily from one village to another. A regular drum-language has been worked out, which the Cameroons man can imitate with his mouth or beat

silently on his breast, and thus converse at his convenience with his countrymen, even in the presence of white men who understand the spoken language. The drum-telegraph does not cease during the whole night, for the Cameroons man is communicative and has much time. The drum is also available as an instrument to dance by. The dances are quite different from those of the civilized world. The sexes being separated, there are no waltzes or contra-dances; there are no pauses for conversation; but the dancing lasts all day, and, when any one gets tired of it, he simply goes away and rests. The performance presents a curious scene, with two fellows beating on their drums as if wild, yet in regular measure, and a company of male or female dancers in action in front of them. These have disposed themselves in a circle, and beginning with short, shuffling steps to the right and left, gradually wax more lively in their motions till the muscles of the legs, arms, and shoulders are all engaged, and the whole body at last gets into a condition of shaking and twisting that no European can imitate. There is, however, no jumping, but a kind of singing, in which a favorite theme is taken up by one of the musicians and joined in by the chorus, which from time to time rises into a regular bellowing. This goes on to the climax, then subsides into a calmer *tempo*, while the performers are gathering strength for a new outburst. The Cameroons music would be tame without the drum. It is therefore taken into the boat, where the song is performed in the same fashion as at the dance. The subjects of the songs are various: sometimes they celebrate the beauty of the canoe; sometimes the good trade which the singers have made; sometimes scorn of their enemies or praise of their friends; and sometimes they are of love. The other musical instruments are of inferior importance as compared with the drum, and include stringed instruments of various construction, in which the resonance is sometimes strengthened by using a hollow gourd shell; and, in King Bell's royal canoe, a bell and an ivory horn.

The Cameroons man is a most passionate trader. Circumstances compel the recognition of a credit system between Europeans and the Duallas. The black comes to the white man and asks for an advance upon the products which he engages to bring. When he brings them he wants another advance, and, keeping this up for several years, he is liable to get considerably behind in the white man's books. The Europeans accordingly find it convenient to "stop the trade" from time to time, and compel the natives to "wash out their accounts" before they will permit any further advances. This they do by agreement among themselves, whereby the native is debarred the opportunity of skipping from one dealer to another. Trade is almost wholly by barter, in which the blacks receive rice, tobacco, spirits, cloth, guns, ammunition,

salt, and knickknacks in exchange for their palm-oil, nuts, and ivory. The Europeans, of course, do not fail to make the bargains profitable to themselves. The unit of values is the "kru," and represents the quantity of goods which the man will receive for a definite quantity of his products. It is a very indefinite standard; for a kru of salt is not worth as much as a kru of cloth, and thus it varies according to the kind of goods in question. It may be rated at about twenty marks German. There are also the "kek," or the quarter-kru, and the "bar," or twentieth of a kru; whence apparently the kru may in the beginning have represented the English pound.

The exchange of his products keeps the Cameroons man very busy. He usually spends the day at the factory in bargaining. For the goods which he has actually brought for the satisfaction of his immediate wants, he usually receives a ticket or "book"; and this little paper is the one thing in the world for which he has a real respect, and by which he will swear. He can not read it, but he has learned that on presenting it he will receive what has been promised him. The mystery of this process seems to him a real enchantment, and he regards it accordingly; and the awe with which it inspires him is extended to all writing.

The objects offered in the factories are not produced by the Cameroons man. He is too idle for that, and prefers to be a middle-man. He buys the goods in "the bush," on such terms as to give him a tremendous profit in the whole transaction. In fact, he cheats the bushman, and because of it conceives a great contempt for him, which he expresses by calling every one whom he regards as dull a bushman.

From time to time the Cameroons man leaves his home, provisions his canoe, and, taking some of his wives with him, is rowed by his slaves into the bush, where he has his appointed trading posts and purveyors. When his boat or boats are filled, he returns to the Cameroons in grand style, and celebrates the end of his expedition with a feast.

The Cameroons man is also a sportsman on the water. The canoe is an exceedingly unstable craft when an inexperienced man is trying to manage it, but the blacks handle it with great skill, and, whether it be a large boat carrying many persons (some of them have capacity for sixty), or built for himself alone, he propels it swiftly, safely, and accurately. A canoe skimming over the water in the panoply of war offers an attractive sight. The boats are handsomely painted in gay colors, and have artistic figure-heads, chiefly representing birds or men, or creatures of fancy. The crew sit on the sides and propel it by dexterous manipulations of the paddles, which they hold with one hand at the end of the handle, and the other close down by the blade; and

they pride themselves on the figures and tricks they can execute with it. The boatmen in these war-vessels delight in arraying themselves with warlike emblems—helmets of goat-skin, guns of all kinds except good ones, swords, and bush-knives. While the war vessels are highly adorned, the trading vessels and those in common use are plain.

On account of their lack of industry, the Cameroons people make very few articles beyond what are necessary for their own use; and it is therefore hard to obtain a satisfactory collection of their products. If they could be taught to apply themselves to anything, they would make most excellent wood-carvers. The figure-heads and models of their canoes, and their chairs, are very fine. They make handsome mats and bags of bast. Their fishing nets and lines do them credit. Carved canes of ebony and calabashes are harder to procure. An ivory-cutter drives a good business in making walking-sticks for persons of means. The gardens, in which banana-trees and yams are the most important plants, are taken care of by the women, who also look after the eggs, committing the sale of them to the young people. The youthful salesmen drive their trade at the factories and the ships. The buyer very carefully tests all the eggs, selecting the good ones, which are usually not in very large proportion to the whole number, and the seller takes his pay and goes with the rejected eggs to the next customer. He takes the best he can find out of the lot, and the seller goes on till he generally manages to dispose of most of his stock. Sometimes a chicken pecks through the egg-shell while the bargain is going on. This vexes the European, but is very enjoyable to the native; for are we not fond of teasing those we love? The egg-merchant uses his mouth for a porte-monnaie, and puts coin after coin into it; when he has to make change, he spits his fund into his hand, and picks out the needed six- and three-penny pieces.

The people also keep goats, which they eat and Europeans do not; swine, whose flesh Europeans reject; in the interior, very small cows, which furnish good meat; dogs; and in the way of pets, parrots, monkeys, chameleons, and crabs.—*Translated for the Popular Science Monthly from Das Ausland.*

THE report of the British Royal Education Commission assumes that if the object of elementary education be the fitting of pupils in general for those duties which they will most probably be called on to perform, instruction in science is only second in importance to instruction in reading, writing, and arithmetic. The soundness of this view is illustrated by the fact, also declared in the report, that the preponderance of opinion among the teachers examined is that no subject is better calculated to awaken the interest and intelligence of the pupils than science.

EVOLUTION AS TAUGHT IN A THEOLOGICAL SEMINARY.

By ROLLO OGDEN.

AT the time of the last hearing of the case of Prof. Woodrow before the General Assembly of the Southern Presbyterian Church, at Baltimore, many of the Johns Hopkins students embraced the opportunity of a lifetime to listen to the expositions of the doctrine of evolution made by so many of the divines of that gathering. It is said that inextinguishable laughter was excited among these young men by their learning how greatly their incompetent professors had misled them as to what evolution really was and meant. It is not often that a theologian can stop to afford such enlightenment to the inquirer in science; and, when he does, it is an obvious duty for one finding such priceless light hidden under a bushel to discover it to the world.

The bushel, in the case in hand, is the two volumes of "Dogmatic Theology," recently published by Prof. Shedd, of Union Theological Seminary, embodying the lectures which he gives in that institution; and the little candle which would surely cast its beams far in this naughty world if really given a chance to shine, is the exposition and annihilation of the doctrine of evolution as given in the chapter on "Creation," vol. i, pp. 499–515. The professor opens the discussion by admitting that there is a "true evolution." This whets curiosity, until it is explained to be the individual development of an organism from its embryo. This being the only "true" evolution, all other kinds are, of course, false, and accordingly are labeled forthwith "pseudo-evolution," under the burden of which eminently calm and philosophical epithet they have to stagger all through the subsequent pages. A better name, however, could not be devised to fit that caricature of the theory which Dr. Shedd sets himself to explain before refuting. It is probably unwitting caricature; the professor is an unconscious humorist. It is, at any rate, charitable to suppose that he jumbles up several different theories into one through ignorance. It would be hard to excuse, on any other ground, his identifying the views of Darwin with those of Spencer and Haeckel. Chauncey Wright long ago pointed out the great differences between these writers. Whatever may be thought of the general theorizings of the last two, it is clear that their method is not the patiently inductive one of Darwin. They are wide-ranging philosophers and rigid systematizers. Darwin was the most matter-of-fact and plodding naturalist, who dreaded of all things getting his feet off the earth. He felt himself lost once out of

sight of facts. His books furnish the best examples of careful induction the world has seen, and it is, of course, for that reason that they have had such immense influence, and that he gave an indestructible life to that cautious working theory of evolution which is to-day the presupposition of all the best work in natural science.

But Prof. Shedd leaves all this out of the account, and knows of no evolution which does not mean the change of a mineral into a vegetable, and of a vegetable into an animal. "Evolution," he says, "is not a mere change of form but of matter." It is true he recurs frequently to Darwin and his specific views, but you can never be sure that he will not fly off to his favorite Haeckel even when apparently farthest from him. This process of mixing up distinct things makes it easy for a disputant, when persecuted in one city, to flee into another, but does not much help one who is after the facts.

This confusion can be forgiven, however, for the sake of the doctor's great lucidity when he comes to state the objections to evolution. Here you always know what he means. We can not follow him all through his enumeration of the difficulties which the theory has to encounter, but will allude to those which are the most novel. The first gun he fires off is formidable enough: "The first objection to the theory of pseudo-evolution is that it is contradicted by the whole course of scientific observation and experiment. It is a theory in the face of facts." That is certainly a serious objection, and one wonders that it had never occurred to any of the scientists who have looked into this matter. It is but another instance of the value of a new point of view. In fact, the thing appears to be mostly intuitive with Prof. Shedd (and, of course, for that reason all the more certain; he stands by the intuitive philosophy), for he advances slight evidence for the statement we have quoted; the gist of what he says being that he never heard of a pigeon being developed out of a cabbage or a piece of quartz, nor of its developing, on the other hand, into a horse. It would be a brazen theory that could hold up its head after such an objection, but the professor seems to fear that evolution needs to be slain at least twice, and so he fires a second fatal shot: "This objection is proved to be true by the failure of the theory to obtain general currency." He means Darwinism now, for all the testimony which he cites bears on that theory. Agassiz is his main tower of strength. The views of a man who died sixteen years ago may be thought to have little to do with what is now "general currency," but that is nothing beside the witness of Haeckel himself. Out of its own mouth Dr. Shedd will judge evolution. He cites a passage from "Creation" in which the German rails at the French for not accepting Darwinism, and

says that even among his own countrymen are to be found many doubters. It is scarcely worth mentioning that this book was written twenty-one years ago, only nine years after the appearance of the "Origin of Species," for it is one of Prof. Shedd's first principles that a proof-text is a proof-text, no matter where you find it. Besides, it is exposition, not comment, that we are at just now.

"If the doctrine be true, it should be supported like that of gravitation by a multitude of undisputed facts and phenomena." The implication is that it is not so supported, and that is pretty tough on the libraries full of books like Müller's "Facts for Darwin." Prof. Shedd takes it very unkindly of Darwin that he never exactly defined a species. Considering that that is one of the things that Darwin said he was perfectly unable to do, and that this very fact led him to believe that there was something mighty queer about species anyhow, it does seem rather hard to bring it up against him now. "Evolution," adds the professor, "conflicts with the certainty of natural science." If it is true, it is the introduction of chance into nature. Anything may happen from anything. This is clear, for the evolutionists themselves say that "variations are accidental." Poor Darwin! after all his pains and endless iteration, there it goes—"accidental." One of the most tiresome things in his books is his constant crying out, "Now, mind you, when I say accidental, I mean according to laws that are not yet discovered." But, after all, here is an order of mind for which he ought to have said it twice as many times.

The embryological argument for evolution attains the high honor of being admitted to be "plausible"; but it is immediately and severely added that this is just the place to apply the maxim, "Judge not by the outward appearance." Naturally, Prof. Shedd is strong on design: "The abundant proof of design in nature overthrows the theory of evolution. This design is executed even in an extreme manner. The mammæ on man's breast and the web-feet of the upland goose show that the plan of structure is carried out with persistence even when in particular circumstances there is no use for the organ itself." If that is hyperborean science, it is dangerously near Hibernian logic, and ought to be called the argument from the usefulness of useless things.

But it is really impossible to keep up the pretense of taking Prof. Shedd's arguments against evolution seriously. Even one who has read in the subject as little as the writer has can not but see that this theologian, in attempting to refute the arguments of the evolutionists, does not know what those arguments are. Take one sentence of his: "If evolution be true, man may evolve into ape as well as ape into man." It would not be possible to construct a single sentence containing a more complete misapprehen-

sion of evolutionary doctrine. Evolution does not assert, it denies that ape evolves into man. Evolution undertakes to show why it is perfectly impossible that man should ever evolve into ape. Prof. Shedd ought to know this, or, if he does not, he ought to refrain from attacking what he does not understand. There is a misprint in one of his pages which is highly significant. He speaks of Darwin's work on "insectivorous animals"! A misprint, of course, yet how characteristically a sign that the author was moving about in a world not realized when he wrote those pages! A scientist reading proof, with a spark of vitality left in him, could no more have passed over that blunder than Prof. Shedd could have passed over a careless expression which might have implied that he believed the mercy of God was of equal rank with his justice. In one case as in the other the thing would have seemed so horrible a mistake that instinct without intellect would have prevented its finally getting printed.

The worst of it is that there is no reason whatever to suspect Dr. Shedd's perfect honesty in all this. When he says that evolution has failed to obtain general currency, he undoubtedly believes it. Evidence to the contrary he either has not read or has not weighed. If he were to see what Romanes says in his latest book, and says wholly in passing, wholly as a matter of course, that there is not living a naturalist of note who is not an evolutionist, he would probably be greatly surprised. If he were to read the evidence gathered a few years ago by the "Independent," and recently by the "Christian Union," going to show that evolution underlies the scientific teaching of all our leading colleges, he would probably be greatly alarmed. I repeat that Prof. Shedd is undoubtedly entirely honest in his ignorance; and I say that that is the worst of it, because it lends the influence of his high character and great learning and unusual ability to the spread of erroneous and disastrous beliefs.

Narrowly considered, it is in reality a conspicuous and crowning testimony to the place which evolution has taken in the thought of the world, that Prof. Shedd should have, at last, taken up the cudgels against it. It is like exerting influence back into the seventeenth century. It is a doctrine of the nineteenth century, making such a din, cutting up so much of the inherited theology by the roots, that Turretin looks out uneasily from his grave to see what the row is all about. Such a remark is in the line of what the professor considers the highest compliment. He prefers to be known as scholastic. A student who listened to a year's lectures from him, a decade ago, reported that but two books written in this century were referred to—and, as one of these was Hodge's "Theology," that, as the student admitted, reduced the number to one. The writer heard the late President

Sturtevant, of Illinois College, narrate an experience of his own with Prof. Shedd, which, as the story was told in general company, may be referred to without any violation of confidence. It was many years ago that he and Prof. Shedd went in company from Andover to Boston, each intending to preach in a Boston pulpit on the following Sunday. They returned on the same train, Monday morning.

"I don't know how it was with you, professor," said President Sturtevant, "but, for myself, I certainly felt like laying unusual stress on evangelical doctrine yesterday, preaching in Boston where so many loose theories are afloat." And Prof. Shedd replied: "I really don't know anything about that. I never read books of that class. All these infidel arguments were so much better put by the writers of the seventeenth century." To have pierced through such an armor is a great achievement, and the counter-attack of the professor is in reality, as has been said, a supreme proof of the immense influence now gained by evolutionary doctrine—a sort of rueful cry, "Thou hast conquered, O Evolution!"

Such complete failure to understand the great contribution to knowledge and speculation made by the theory of evolution can not but have a most deplorable influence when found in one occupying so prominent a chair of instruction in so prominent an institution. A fair proportion of Prof. Shedd's students come from colleges where they have been taught to regard evolution as one of the settled things. They must come out from their lectures in Union Seminary either dazed or indignant. Others, of course, who have either taken a short cut to the ministry, or have had their only education in some ecclesiastically controlled school where they have met no competent teacher of natural science, take in all that they are told on this, as on other subjects, and go out to swell the number of ministers who know nothing of the revolution wrought in human thought in the past thirty years. They are the men who do all they can (of course unwittingly) to make Christian belief an impossibility to a large class of intelligent and educated young men. One of that class came to his pastor, not long ago, and said: "I was at the meeting of the Benighted Presbytery last week, and they were talking about evolution as a very dangerous thing, and finally passed a resolution condemning it. I thought that everybody accepted evolution." That young Presbyterian was a graduate of Harvard, and learned of Prof. Gray (who, by the way, is a Balaam whom Prof. Shedd in delightful innocence summons to curse evolution) to reconcile evolution with theistic and even Christian belief, and was not unnaturally surprised at running up against a chunk of the last century.

It would be wholly unfair to give the impression that such

treatment of evolution as Prof. Shedd's is the regular thing in our theological seminaries. In a few of them there is a frank acceptance of the main positions of evolutionary teaching; in many of them there is a growing care not to antagonize evolution as flatly as was once customary, and to lay down theological propositions which would not be entirely swept away if it should turn out that evolution should finally have to be admitted to be established. Archbishop Whately used to say that the attitude of the clergy to new scientific doctrines was marked by three definite stages: "At first they say, 'It is ridiculous'; then they affirm, 'It is contradicted by the Bible'; at last they declare, 'We always believed it.'" All these stages are represented in the teaching of the seminaries—to which one Union should be assigned may be inferred from what has gone before. It will certainly not be Prof. Shedd's fault if the institution which he serves does not prove to be the one to come to mind as the best illustration of Horace Bushnell's remark: "Some theological seminaries are not only behind the age, but behind all ages."

THE ART OF PROLONGING LIFE.

By Dr. ROBSON ROOSE.

THE doctrine that a short life is a sign of divine favor has never been accepted by the majority of mankind. Philosophers have vied with each other in depicting the evils and miseries incidental to existence, and the truth of their descriptions has often been sorrowfully admitted, but they have failed to dislodge, or even seriously diminish, that desire for long life which has been deeply implanted within the hearts of men. The question whether life be worth living has been decided by a majority far too great to admit of any doubt upon the subject, and the voices of those who would fain reply in the negative are drowned amid the chorus of assent. Longevity, indeed, has come to be regarded as one of the grand prizes of human existence, and reason has again and again suggested the inquiry whether care or skill can increase the chances of acquiring it, and can make old age, when granted, as comfortable and happy as any other stage of our existence.

From very early times the art of prolonging life, and the subject of longevity, have engaged the attention of thinkers and essayists; and some may perhaps contend that these topics, admittedly full of interest, have been thoroughly exhausted. It is true that the art in question has long been recognized and practiced, but the science upon which it really depends is of quite mod-

ern origin. New facts connected with longevity have, moreover, been collected within the last few years, and some of these I propose to examine, and further to inquire whether they teach us any fresh means whereby life may be maintained and prolonged.

But, before entering upon the immediate subject, there are several preliminary questions which demand a brief examination, and the first that suggests itself is, What is the natural duration of human life? This oft-repeated question has received many different answers; and inquiry has been stimulated by skepticism as to their truth. The late Sir George Cornewall Lewis expressed the opinion that one hundred years must be regarded as a limit which very few, if indeed any, human beings succeed in reaching, and he supported this view by several cogent reasons. He pointed out that almost all the alleged instances of abnormal longevity occurred among the humbler classes, and that it was difficult, if not impossible, to obtain any exact information as to the date of birth and to identify the individuals with any written statements that might be forthcoming. He laid particular stress upon the fact that similar instances were altogether absent among the higher classes, with regard to whom trustworthy documentary evidence was almost always obtainable. He thought that the higher the rank the more favorable would the conditions be for the attainment of a long life. In this latter supposition, however, Sir George Lewis was probably mistaken: the comforts and luxuries appertaining to wealth and high social rank are too often counterbalanced by cares and anxieties, and by modes of living inconsistent with the maintenance of health, and therefore with the prolongation of life. In the introduction to his work on "Human Longevity," Easton says, "It is not the rich or great . . . that become old, but such as use much exercise, are exposed to the fresh air, and whose food is plain and moderate—as farmers, gardeners, fishermen, laborers, soldiers, and such men as perhaps never employed their thoughts on the means used to promote longevity."

The French naturalist, Buffon, believed that, if accidental causes could be excluded, the normal duration of human life would be between ninety and one hundred years, and he suggested that it might be measured (in animals as well as in man) by the period of growth, to which it stood in a certain proportion. He imagined that every animal might live for six or seven times as many years as were requisite for the completion of its growth. But this calculation is not in harmony with facts, so far, at least, as man is concerned. His period of growth can not be estimated at less than twenty years; and if we take the lower of the two multipliers, we get a number which, in the light of modern evidence, can not be accepted as attainable. If the period of growth

be multiplied by five, the result will in all probability not be far from the truth.

If we seek historical evidence, and from it attempt to discover the extreme limit of human life, we are puzzled at the differences in the ages said to have been attained. The longevity of the antediluvian patriarchs when contrasted with our modern experience seems incredible. When we look at an individual, say ninety years of age, taking even the most favorable specimen, a prolongation of life to ten times that number of years would appear too absurd even to dream about. There is certainly no physiological reason why the ages assigned to the patriarchs should not have been attained, and it is useless to discuss the subject, for we know very little of the conditions under which they lived. It is interesting to notice that after the Flood there was a gradual decrease in the duration of life. Abraham is recorded to have died at one hundred and seventy-five; Joshua, some five hundred years later, "waxed old and stricken in age" shortly before his death at one hundred and ten years; and his predecessor, Moses, to whom one hundred and twenty years are assigned, is believed to have estimated the life of man at threescore years and ten—a measure nowadays pretty generally accepted.

There is no reason for believing that the extreme limit of human life in the time of the Greeks and Romans differed materially from that which agrees with modern experience. Stories of the attainment of such ages as one hundred and twenty years and upward may be placed in the same category as the reputed longevity of Henry Jenkins, Thomas Parr, Lady Desmond, and a host of others. With regard to later times, such as the middle ages, there are no precise data upon which any statements can be based, but there is every reason to believe that the *average* duration of life was decidedly less than it is at present. The extreme limit, indeed, three or four centuries ago, would appear to have been much lower than it is in the nineteenth century. At the request of Mr. Thoms, Sir J. Duffus Hardy investigated the subject of the longevity of man in the thirteenth, fourteenth, fifteenth, and sixteenth centuries, and his researches led him to believe that persons seldom reached the age of eighty. He never met with a trustworthy record of a person who exceeded that age.

To bring the investigation down to quite recent times, I can not do better than utilize the researches of Dr. Humphry, Professor of Surgery at Cambridge. In 1886 he obtained particulars relating to fifty-two individuals then living and said to be one hundred years old and upward. The oldest among them claimed to be one hundred and eight, the next one hundred and six, while the average amounted to a little more than one hundred and two years. Many interesting facts connected with the habits and

mode of life of these individuals were obtained by Dr. Humphry, and will be referred to in subsequent paragraphs.

A short account of the experience of a few life-assurance companies will conclude this part of my subject. Mr. Thoms tells us that down to 1872 the records of the companies showed that one death among the assured had occurred at one hundred and three, one in the one hundredth, and three in the ninety-ninth year. The experience of the National Debt Office, according to the same authority, gave two cases in which the evidence could be regarded as perfect; one of these died in the one hundred and second year, and the other had just completed that number. In the tables published by the Institute of Actuaries, and giving the mortality experience down to 1863 of twenty life-assurance companies, the highest age at death is recorded as ninety-nine; and I am informed by the secretary of the Edinburgh Life Office that from 1863 onward that age had not been exceeded in his experience. In the valuation schedules, which show the highest ages of existing lives in various offices, the ages range from ninety-two to ninety-five. It is true that one office which has a large business among the industrial classes reports lives at one hundred and three, and in one instance at one hundred and seven; but it must be remembered that among those classes the ages are not nearly so well authenticated as among those who assure for substantial sums. There is, moreover, another source of error connected with the valuation schedules. When a given life is not considered to be equal to the average, a certain number of years is added to the age, and the premium is charged at the age which results from this addition. It follows, therefore, that in some cases the ages given in the schedules are greater by some years than they really are.

Taking into consideration the facts thus rapidly passed under review, it must, I think, be admitted that the natural limit of human existence is that assigned to it in the book of Ecclesiasticus, "The number of a man's days at the most are an hundred years" (chapter xviii. 9). In a very small number of cases this limit is exceeded, but only by a very few years. Mr. Thoms's investigations conclusively show that trustworthy evidence of one hundred and ten years having been reached is altogether absent. Future generations will be able to verify or reject statements in all alleged cases of longevity. It must be remembered that previous to the year 1836 there was no registration of births, but only of baptisms, and that the registers were kept in the churches, and contained only the names of those therein baptized.

Whatever number of years may be taken as representing the natural term of human life, whether threescore and ten or a century be regarded as such, we are confronted by the fact that only

one fourth of our population attains the former age, and that only about fifteen in one hundred thousand become centenarians. It is beyond the scope of this article to discuss the causes of premature mortality, but the conditions favorable to longevity, and the causes to which length of days has been assigned, are closely connected with its subject.

A capability of attaining old age is very often handed down from one generation to another, and heredity is probably the most powerful factor in connection with longevity. A necessary condition of reaching advanced age is the possession of sound bodily organs, and such an endowment is eminently capable of transmission. Instances of longevity characterizing several generations are frequently brought to notice. A recent and most interesting example of transmitted longevity is that of the veteran guardian of the public health, Sir Edwin Chadwick, who was entertained at a public dinner a few weeks ago on the occasion of his reaching his ninetieth year. He informed his entertainers that his father died at the age of eighty-four, his grandfather at ninety-five, and that two more remote ancestors were centenarians.

It is difficult to estimate the influence of other contingencies which affect longevity. With regard to sex, Hufeland's opinion was that women were more likely than men to become old, but that instances of extreme longevity were more frequent among men. This opinion is to some extent borne out by Dr. Humphry's statistics: of his fifty-two centenarians, thirty-six were women. Marriage would appear to be conducive to longevity. A well-known French *savant*, Dr. Bertillon, states that a bachelor of twenty-five is not a better life than a married man of forty-five, and he attributes the difference in favor of married people to the fact that they take more care of themselves, and lead more regular lives than those who have no such tie. It must, however, be remembered that the mere fact of marrying indicates superior vitality and vigor, and the ranks of the unmarried are largely filled by the physically unfit.

In considering occupations as they are likely to affect longevity, those which obviously tend to shorten life need not be considered. With respect to the learned professions, it would appear that among the clergy the average of life is beyond that of any similar class. It is improbable that this average will be maintained for the future; the duties and anxieties imposed upon the clergy of the present generation place them in a very different position from that of their predecessors. Among lawyers there have been several eminent judges who attained a great age, and the rank and file of the profession are also characterized by a decided tendency to longevity. The medical profession supplies but few instances of extreme old age, and the average duration

of life among its members is decidedly low, a fact which can be easily accounted for. Broken rest, hard work, anxieties, exposure to weather and to the risks of infection can not fail to exert an injurious influence upon health. No definite conclusions can be arrived at with regard to the average longevity of literary and scientific men, but it might be supposed that those among them who are not harassed by anxieties and enjoy fair health would probably reach old age. As a general rule, the duration of life is not shortened by literary pursuits. A man may worry himself to death over his books, or, when tired of them, may seek recreation in pursuits destructive to health; but application to literary work tends to produce cheerfulness, and to prolong rather than shorten the life even of an infirm man. In Prof. Humphry's "Report on Aged Persons," containing an account of eight hundred and twenty-four individuals of both sexes, and between the ages of eighty and one hundred, it is stated that forty-eight per cent were poor, forty-two per cent were in comfortable circumstances, and only ten per cent were described as being in affluent circumstances. Dr. Humphry points out that these ratios "must not be regarded as representing the relations of poverty and affluence to longevity, because, in the first place, the poor at all ages and in all districts bear a large proportion to the affluent; and, secondly, the returns are largely made from the lower and middle classes, and in many instances from the inmates of union workhouses, where a good number of aged people are found." It must also be noticed that the "past life-history" of these individuals showed that the greater proportion (fifty-five per cent) "had lived in comfortable circumstances," and that only thirty-five per cent had been poor.

Merely to enumerate the causes to which longevity has been attributed in attempting to account for individual cases would be a task of some magnitude; it will be sufficient to mention a few somewhat probable theories. Moderation in eating and drinking is often declared to be a cause of longevity, and the assertion is fully corroborated by Dr. Humphry's inquiries. Of his fifty-two centenarians, twelve were recorded as total abstainers from alcoholic drinks throughout life, or for long periods; twenty had taken very little alcohol; eight were reported as moderate in their use of it; and only three habitually indulged in it. It is quite true that a few persons who must be classified as drunkards live to be very old; but these are exceptions to the general rule, and such cases appear to be more frequent than they really are, because they are often brought to notice by those who find encouragement from such examples. The habit of temperance in food, good powers of digestion, and soundness of sleep are other main characteristics of most of those who attain advanced years, and may

be regarded as causes of longevity. Not a few old persons are found on inquiry to take credit to themselves for their own condition, and to attribute it to some remarkable peculiarity in their habits or mode of life. It is said that Lord Mansfield, who reached the age of eighty-nine, was wont to inquire into the habits of life of all aged witnesses who appeared before him, and that only in one habit, namely, that of early rising, was there any general concurrence. Health is doubtless often promoted by early rising, but the habit is not necessarily conducive to longevity. It is, as Sir H. Holland points out, more probable that the vigor of the individuals maintains the habit than that the latter alone maintains the vitality.

If we pass from probable to improbable causes of longevity we are confronted by many extravagant assumptions. Thus, to take only a few examples, the immoderate use of sugar has been regarded not only as a panacea, but as decidedly conducive to length of days. Dr. Slare, a physician of the last century, has recorded the case of a centenarian who used to mix sugar with all his food, and the doctor himself was so convinced of the "balsamic virtue" of this substance that he adopted the practice, and boasted of his health and strength in his old age. Another member of the same profession used to take daily doses of tannin (the substance employed to harden and preserve leather), under the impression that the tissues of the body would be thereby protected from decay. His life was protracted beyond the ordinary span, but it is questionable whether the tannin acted in the desired direction. Lord Combermere thought that his good health and advanced years were due, in part at least, to the fact that he always wore a tight belt round his waist. His lordship's appetite was doubtless thereby kept within bounds; we are further told that he was very moderate in the use of all fluids as drink. Cleanliness might be supposed to aid in prolonging life, yet a Mrs. Lewson, who died in the early part of this century, aged one hundred and six, must have been a singularly dirty person. We are told that instead of washing she smeared her face with lard, and asserted that "people who washed always caught cold." This lady, no doubt, was fully persuaded that she had discovered the universal medicine.

Many of the alchemists attributed the power of prolonging life to certain preparations of gold, probably under the idea that the permanence of the metal might be imparted to the human system. Descartes is said to have favored such opinions: he told Sir Kenelm Digby that, although he would not venture to promise immortality, he was certain that his life might be lengthened to the period of that enjoyed by the patriarchs. His plan, however, seems to have been the very rational and simple one of checking all excesses and enjoining punctual and frugal meals.

Having thus endeavored to show the extent to which human life may be prolonged, and having examined some of the causes or antecedents of longevity, the last subject for inquiry is the means by which it may be attained. Certain preliminary conditions are obviously requisite; in the first place there must be a sound constitution derived from healthy ancestors, and in the second there must be a freedom from organic disease of important organs. Given an individual who has reached the grand climacteric, or threescore and ten, and in whom these two conditions are fulfilled, the means best adapted to maintain and prolong his life constitute the question to be solved. It has been said that "he who would long to be an old man must begin early to be one," but very few persons designedly take measures in early life in order that they may live longer than their fellows.

The whole term of life may be divided into the three main periods of growth and development, of maturity, and of decline. No hard and fast line can be drawn between these two latter phases of existence: the one should pass gradually into the other until the entire picture is changed. Diminished conservative power and the consequent triumph of disintegrating forces are the prominent features of the third period, which begins at different times in different individuals, its advent being mainly controlled by the general course of the preceding years. The "turning period," also known as the "climacteric" or "middle age," lies between forty-five and sixty; the period beyond may be considered as belonging to advanced life or old age. The majority of the changes characteristic of these last stages are easily recognizable. It is hardly necessary to mention the wrinkled skin, the furrowed face, the "crow's feet" beneath the eyes, the stooping gait, and the wasting of the frame. The senses, notably vision and hearing, become less acute; the power of digestion is lessened; the force of the heart is diminished; the lungs are less permeable; many of the air-cells lose their elasticity and merge into each other, so that there is less breathing surface as well as less power. Simultaneously with these changes the mind may present signs of enfeeblement; but in many instances its powers long remain in marked contrast with those of the body. One fact connected with advanced life is too often neglected. It should never be forgotten that while the "forces in use" at that period are easily exhausted, the "forces in reserve" are often so slight as to be unable to meet the smallest demand. In youth, the *vires in posse* are superabundant; in advanced life, they are reduced to a minimum, and in some instances are practically non-existent. The recognition of this difference is an all-important guide in laying down rules for conduct in old age.

In order to prolong life and at the same time to enjoy it, occu-

pation of some kind is absolutely necessary; it is a great mistake to suppose that idleness is conducive to longevity. It is at all times better to wear out than to rust out, and the latter process is apt to be speedily accomplished. Every one must have met with individuals who, while fully occupied till sixty or even seventy years of age, remained hale and strong, but aged with marvelous rapidity after relinquishing work, a change in their mental condition becoming especially prominent. There is an obvious lesson to be learned from such instances, but certain qualifications are necessary in order to apply it properly. With regard to mental activity, there is abundant evidence that the more the intellectual faculties are exercised the greater the probability of their lasting. They often become stronger after the vital force has passed its culminating point; and this retention of mental power is the true compensation for the decline in bodily strength. Did space permit, many illustrations could be adduced to show that the power of the mind can be preserved almost unimpaired to the most advanced age. Even memory, the failure of which is sometimes regarded as a necessary concomitant of old age, is not infrequently preserved almost up to the end of life. All persons of middle age should take special pains to keep the faculties and energies of the mind in a vigorous condition; they should not simply drift on in a hap-hazard fashion, but should seek and find pleasure in the attainment of definite objects. Even if the mind has not been especially cultivated, or received any decided bent, there is at the present day no lack of subjects on which it can be agreeably and profitably exercised. Many sciences which, twenty or thirty years ago, were accessible only to the few, and wore at best a somewhat uninviting garb, have been rendered not merely intelligible but even attractive to the many; and in the domain of general literature the difficulty of making a choice among the host of allurements is the only ground for complaint. To increase the taste for these and kindred subjects is worth a considerable effort, if such be necessary; but the appetite will generally come with the eating. The possession of some reasonable hobby which can be cultivated indoors is a great advantage in old age, and there are many pursuits of this character besides those connected with literature and science. Talleyrand laid great stress on a knowledge of whist as indispensable to a happy old age, and doubtless to many old people that particular game affords not only recreation but a pleasant exercise to the mind. It is, however, an unworthy substitute for higher objects, and should be regarded only as an amusement and not as an occupation.

Whatever be the sphere of mental activity, no kind of strain must be put upon the mind by a person who has reached sixty-five or seventy years. The feeling that mental power is less than

it once was not infrequently stimulates a man to increased exertions which may provoke structural changes in the brain, and will certainly accelerate the progress of any that may exist in that organ. When a man finds that a great effort is required to accomplish any mental task that was once easy, he should desist from the attempt, and regulate his work according to his power. With this limitation, it may be taken for granted that the mental faculties will be far better preserved by their exercise than by their disuse.

Somewhat different advice must be given with regard to bodily exercises in their reference to longevity. Exercise is essential to the preservation of health; inactivity is a potent cause of wasting and degeneration. The vigor and equality of the circulation, the functions of the skin, and the aëration of the blood, are all promoted by muscular activity, which thus keeps up a proper balance and relation between the important organs of the body. In youth, the vigor of the system is often so great that if one organ be sluggish another part will make amends for the deficiency by acting vicariously, and without any consequent damage to itself. In old age, the tasks can not be thus shifted from one organ to another; the work allotted to each sufficiently taxes its strength, and vicarious action can not be performed without mischief. Hence the importance of maintaining, as far as possible, the equable action of all the bodily organs, so that the share of the vital processes assigned to each shall be properly accomplished. For this reason exercise is an important part of the conduct of life in old age; but discretion is absolutely necessary. An old man should discover by experience how much exercise he can take without exhausting his powers, and should be careful never to exceed the limit. Old persons are apt to forget that their staying powers are much less than they once were, and that, while a walk of two or three miles may prove easy and pleasurable, the addition of a return journey of similar length will seriously overtax the strength. Above all things, sudden and rapid exertion should be scrupulously avoided by persons of advanced age. The machine which might go on working for years at a gentle pace often breaks down altogether when its movements are suddenly accelerated. These cautions may appear superfluous, but instances in which their disregard is followed by very serious consequences are by no means infrequent.

No fixed rule can be laid down as to the kind of exercise most suitable for advanced age. Much must depend upon individual circumstances and peculiarities; but walking in the open air should always be kept up and practiced daily, except in unfavorable weather. Walking is a natural form of exercise and subserves many important purposes: not a few old people owe the maintenance of their health and vigor to their daily "constitu-

tional." Riding is an excellent form of exercise, but available only by a few; the habit, if acquired in early life, should be kept up as long as possible, subject to the caution already given as to violent exercise. Old persons of both sexes fond of gardening, and so situated that they may gratify their tastes, are much to be envied. "Fortunati nimium, sua si bona nôrint!"* Body and mind are alike exercised by what Lord Bacon justly termed "the purest of human pleasures." Dr. Parkes goes so far as to say that light garden or agricultural work is a very good exercise for men past seventy: "It calls into play the muscles of the abdomen and back, which in old men are often but little used, and the work is so varied that no muscle is kept long in action." A few remarks must be made, in conclusion, with regard to a new form of exercise sometimes indulged in even by elderly men. I allude to so-called "tricycling." Exhilarating and pleasant as it may be to glide over the ground with comparatively little effort, the exercise is fraught with danger for men who have passed the grand climacteric. The temptation to make a spurt must be often irresistible; hills must be encountered, some perhaps so smooth and gradual as to require no special exertion, none, at least, that is noticed in the triumph of surmounting them. Now, if the heart and lungs be perfectly sound, such exercises may be practiced for some time with *apparent* impunity; but if (as is very likely to be the case) these organs be not quite structurally perfect, even the slightest changes will, under such excitement, rapidly progress and lead to very serious results. Exercise unsuited to the state of the system will assuredly not tend to the prolongation of life.

With regard to food, we find from Dr. Humphry's report that ninety per cent of the aged persons were either "moderate" or "small" eaters, and such moderation is quite in accord with the teachings of physiology. In old age the changes in the bodily tissues gradually become less and less active, and less food is required to make up for the daily waste. The appetite and the power of digestion are correspondingly diminished, and although for the attainment of a great age a considerable amount of digestive power is absolutely necessary, its perfection, when exercised upon proper articles of diet, is the most important characteristic. Indulgence in the pleasures of the table is one of the common errors of advanced life, and is not infrequent in persons who, up to that period, were moderate or even small eaters. Luxuries in the way of food are apt to be regarded as rewards that have been fully earned by a life of labor, and may, therefore, be lawfully enjoyed. Hence arise many of the evils and troubles of old age, and notably indigestion and gouty symptoms in various forms, besides mental discomfort. No hard and fast rules can be laid down, but

* [Fortunate beyond measure if they know their own advantages.]

strict moderation should be the guiding maxim. The diet suitable for most aged persons is that which contains much nutritive material in a small bulk, and its quantity should be in proportion to the appetite and power of digestion. Animal food, well cooked, should be taken sparingly and not more often than twice a day, except under special circumstances. Dr. Parkes advocates rice as a partial substitute for meat when the latter is found to disagree with old persons. "Its starch-grains are very digestible, and it supplies nitrogen in moderate amount, well fitted to the worn and slowly repaired tissues of the aged." Its bulk, however, is sometimes a disadvantage; in small quantities it is a valuable addition to milk and to stewed fruits.

The amount of food taken should be divided between three or four meals at fairly regular intervals. A sense of fullness or oppression after eating ought not to be disregarded. It indicates that the food taken has been either too abundant or of improper quality. For many elderly people the most suitable time for the principal meal is between 1 and 2 P. M. As the day advances the digestive powers become less, and even a moderately substantial meal taken in the evening may seriously overtask them. Undigested food is a potent cause of disturbed sleep, an evil often very troublesome to old people, and one which ought to be carefully guarded against.

It is an easier task to lay down rules with regard to the use of alcoholic liquors by elderly people. The Collective Investigation Committee of the British Medical Association has lately issued a "Report on the Connection of Disease with Habits of Intemperance," and two at least of the conclusions arrived at are worth quoting: "Habitual indulgence in alcoholic liquors, beyond the most moderate amount, has a distinct tendency to shorten life, the average shortening being roughly proportional to the degree of indulgence. Total abstinence and habitual temperance augment considerably the chance of death from old age or natural decay, without special pathological lesion." Subject, however, to a few exceptions, it is not advisable that a man sixty-five or seventy years of age, who has taken alcohol in moderation all his life, should suddenly become an abstainer. Old age can not readily accommodate itself to changes of any kind, and to many old people a little good wine with their meals is a source of great comfort. To quote again from Ecclesiasticus, "Wine is as good as life to a man, if it be drunk moderately, for it was made to make men glad." Elderly persons, particularly at the close of the day, often find that their nervous energy is exhausted, and require a little stimulant to induce them to take a necessary supply of proper nourishment, and perhaps to aid the digestive powers to convert their food to a useful purpose. In the debility of old

age, and especially when sleeplessness is accompanied by slow and imperfect digestion, a small quantity of a generous and potent wine, containing much ether, often does good service. Even a little beer improves digestion in some old people; others find that spirits, largely diluted, fulfill the same purpose. Individual peculiarities must be allowed for; the only general rule is that which prescribes strict moderation.

It is not to be inferred from the hints given in the preceding paragraphs that the preservation of health should be the predominant thought in the minds of elderly persons who desire that their lives should be prolonged. To be always guarding against disease, and to live in a state of constant fear and watchfulness, would make existence miserable and hasten the progress of decay. Selfish and undue solicitude with regard to health not only fails to attain its object, but is apt to induce that diseased condition of mind known as hypochondriasis, the victims of which are always a burden and a nuisance, if not to themselves, at least to all connected with them. Addison, in the "Spectator," after describing the valetudinarian who constantly weighed himself and his food, and yet became sick and languishing, aptly remarks, "A continual anxiety for life vitiates all the relishes of it, and casts a gloom over the whole face of nature, as it is impossible that we should take delight in anything that we are every moment afraid of losing."

Sleep is closely connected with the question of diet; "good sleeping" was a noticeable feature in the large majority of Dr. Humphry's cases. Sound, refreshing sleep is of the utmost consequence to the health of the body, and no substitute can be found for it as a restorer of vital energy. Sleeplessness is, however, often a source of great trouble to elderly people, and one which is not easily relieved. Narcotic remedies are generally mischievous; their first effects may be pleasant, but the habit of depending upon them rapidly grows until they become indispensable. When this stage has been reached, the sufferer is in a far worse plight than before. In all cases the endeavor should be made to discover whether the sleeplessness be due to any removable cause—such as indigestion, cold, want of exercise, and the like. In regard to sleeping in the daytime, there is something to be said both for and against that practice. A nap of "forty winks" in the afternoon enables many aged people to get through the rest of the day in comfort, whereas they feel tired and weak when deprived of this refreshment. If they rest well at night there can be no objection to the afternoon nap; but if sleeplessness be complained of, the latter should be discontinued for a time. Most old people find that a reclining posture, with the feet and legs raised, is better than the horizontal position for the afternoon nap. Digestion proceeds with more ease than when the body is recumbent.

Warmth is very important for the aged; exposure to chills should be scrupulously avoided. Bronchitis is the malady most to be feared, and its attacks are very easily provoked. Many old people suffer from more or less cough during the winter months, and this symptom may recur year after year, and be almost unheeded. At last, perhaps a few minutes' exposure to a cold wind increases the irritation in the lungs, the cough becomes worse, and the difficulty of breathing increases until suffocation terminates in death. To obviate such risk the skin should be carefully protected by warm flannel clothes, the outdoor thermometer should be noticed, and winter garments should always be at hand. In cold weather the lungs should be protected by breathing through the nose as much as possible, and by wearing a light woolen or silken muffler over the mouth. The temperature of the sitting- and bed-rooms is another point which requires attention. Some old people pride themselves on never requiring a fire in their bedrooms. It is, however, a risky practice to exchange a temperature of 65° or 70° for one fifteen or twenty degrees lower. As a general rule, for persons sixty-five years of age and upward, the temperature of the bed-room should not be below 60°, and when there are any symptoms of bronchitis it should be raised from five to ten degrees higher.

Careful cleansing of the skin is the last point which needs to be mentioned in an article like the present. Attention to cleanliness is decidedly conducive to longevity, and we may congratulate ourselves on the general improvement in our habits in this respect. Frequent washing with warm water is very advantageous for old people, in whom the skin is only too apt to become hard and dry; and the benefit will be increased if the ablutions be succeeded by friction with coarse flannel or linen gloves, or with a flesh-brush. Every part of the skin should be thus washed and rubbed daily. The friction removes worn-out particles of the skin, and the exercise promotes warmth and excites perspiration. Too much attention can hardly be paid to the state of the skin; the comfort of the aged is greatly dependent upon the proper discharge of its functions.

Such, then, are the principal measures by which life may be prolonged and health maintained down to the closing scene. It remains to be seen whether, as a result of progress of knowledge and civilization, life will ever be protracted beyond the limit assigned to it in a preceding paragraph. There is no doubt that the *average duration* of human life is capable of very great extension, and that the same causes which serve to prolong life materially contribute toward the happiness of mankind. The experience of the last few decades abundantly testifies to the marked improvement which has taken place in the public health. Statistics show

that at the end of the septennial period, 1881–'87, 400,000 persons were alive in England and Wales whose death would have taken place had the mortality been in the same proportion as during the previous decade. It may be reasonably expected that as time goes on there will be an increase in the proportion of centenarians to the population as a whole.

The question whether long life is, after all, desirable does not admit of any general answer. Much depends upon the previous history of the individual, and his bodily and mental condition. The last stages of a well-spent life may be the happiest, and while sources of enjoyment exist, and pain is absent, the shuffling-off of the mortal coil, though calmly expected, need not be wished for. The picture afforded by cheerful and mellow old age is a lesson to younger generations. Elderly people may, if they choose, become centers of improving and refining influence. On the other hand, old age can not be regarded as a blessing when it is accompanied by profound decrepitude and disorder of mind and body. Senile dementia, or second childishness, is, of all conditions, perhaps the most miserable, though not so painful to the sufferer as to those who surround him. Its advent may be accelerated by ignorance and neglect, and almost assuredly retarded or prevented by such simple measures as have been suggested. No one who has had opportunities of studying old people can shut his eyes to the fact that many of the incapabilities of age may be prevented by attention to a few simple rules, the observance of which will not only prolong life and make it happier and more comfortable, but will reduce to a minimum the period of decrepitude. Old age may be an incurable disease, admitting of but one termination, but the manner of that end, and the condition which precedes it, are, though not altogether, certainly to a very great extent, within our own power.—*Fortnightly Review.*

NOTE.—Since the above was sent to press, the civilized world has lost its most noted centenarian in the person of M. Chevreul, the famous French chemist, who died on the 9th of April, aged one hundred and two years and seven months. Only a few days before his death he went in his carriage to see the Eiffel Tower, in which he took a lively interest. Throughout his long life he had worked hard, sparing neither mind nor body, and it would seem that his faculties were preserved with but slight impairment up to the time of his death.

IT is observed by Mr. Stanley, in one of his recent letters from Central Africa, that Nejambi Rapids, about two hundred and fifty miles above the junction of the Aruwimi and Congo Rivers, marks the division between two different kinds of architecture and language. Below, the cone-huts are to be found; above the rapids we have villages, long and straight, of detached square huts surrounded by tall logs, which form separate courts, and add materially to the strength of the village.

EDUCATION IN ANCIENT EGYPT.

By F. C. H. WENDEL, A.M., Ph.D.

THE first state to recognize the necessity of education was ancient Egypt. The period referred to here is from 4000 B.C. to the time of Christ; but it is only of about fifteen hundred years of this period—2530–1000 B.C.—that we know the educational conditions. But education here was not popular education. The ancient Egyptians had no care of the populace; they educated only their officials. The government consisted of the departments of state, treasury, and justice. Each of these departments had its own schools, in which young men were trained for the work of the department; but it is only of the treasury schools that we know anything, and of these we do not know any details. Besides these department schools of the general government, there was a number of department schools in the various nomes into which Egypt was divided.* These schools did not purpose to give their pupils a liberal education, but merely to train up competent officials, and in this they succeeded admirably. The efficiency of the various departments is traceable, to a great extent, to the excellent training their officials received in these schools.

It is a significant fact that all boys, rich or poor, of lofty or humble birth, were received into these schools. In the earliest times, boys born on the same day with the prince royal were educated together with him; but in later times this custom was stopped, possibly because the prince royal attended the same department schools as those of humbler parentage. No distinction of castes existed, and no discrimination was made, either by the teachers or the government, between scribes (i.e., students or officials) of lofty birth and those of humbler antecedents. It is true that in ancient Egypt, as everywhere else, influence went a great way after a young man had entered the actual service of the government; but it is equally true that specially efficient officials of lowly birth advanced step by step to the highest offices in the gift of the government. All, the rich as well as the poor, advanced step by step from the lower offices to the higher, the prince royal being compelled to go through the same course of training and to advance through the same offices as the laborer's son, though, of course, his progress was more rapid, and in the end he

* Egypt was not always what it appears in historic times, a political whole; on the contrary, we have abundant proof that it was for a long while divided into two nations, the north and south countries, which were by Mena, about 4000 B.C., united under one scepter, much as Sweden and Norway are to-day. Each of these two countries, again, was a composite product, the resultant of the union of various small districts which we are accustomed to call *nomes*. These nomes retained all through antiquity a certain autonomy, having their own governments modeled after the general government, and their hereditary rulers.

attained to higher offices than his humbler companions, there being certain offices open to him alone. But, with this single exception, the poor man's son could by efficiency accomplish the same results as the rich man's and the prince's son. The only test was efficiency, and this test was applied most rigidly and in a thoroughly democratic manner, giving all an equal chance.

It was, furthermore, left entirely to the option of a young man or his parents what occupation he should fit himself for. If the father was a treasury official, a priest, or an officer, it did not necessarily follow that the son should also be a treasury official, a priest, or an officer; nor yet, if the father was a merchant, mechanic, or farmer, did it necessarily follow that the son should also be a merchant, mechanic, or farmer. In some families we find several members in the government service; while others, having no titles, were private citizens engaged in civic pursuits. As a further confirmation of this fact, we have a didactic poem, written by a certain Daauf, in which he advises his son Pepy to become a scribe—i. e., a government official. In this exceedingly interesting poem he sketches the misery of all that are not in the service. His sketches are of course prejudiced, as he seeks to influence his son to enter the government service; but, nevertheless, the poem plainly shows that the choice of occupation was left to the young man. The poem closes with a couplet that was often quoted in later writings:

> "Lo, there is no class that is not governed;
> Only the scribe; he is a governor!"

The Egyptians were *stern utilitarians*, and thus they esteemed learning, not for its own sake, but merely for the *practical* advantages it conferred upon its happy possessor. They were not intellectualists and idealists, like the ancient Greeks, nor yet were they seekers after truth, like our modern scholars. They were practical men, and sought to attain learning for practical ends. They devoted themselves to their studies in order to fit themselves for the government service. They argued much in the line of Daauf's old poem. The burden of all they have written on the subject is always the same: The scribe alone is free; he need do no manual labor, but leads a pleasant and agreeable life; the government provides for him. And, then, to think of all the honors he may attain to! The diligent scribe is sure to rise, and may even gain princely rank. But to attain this he must be diligent. "Work, work, study, study, grind, grind," is also a continuous burden of this class of writings.

Boys intended for the government service entered the school at a very early age. The course of instruction was very simple. The first care of the teacher was to initiate the young scribe into the mysteries of the art of writing. After he had mastered the

first difficulties, he was given older texts to copy. These texts were moral treatises, older poems, fairy tales, religious and mythical writings, and letters. It is to this fact that we owe the preservation of the greater part of the literary remains of ancient Egypt. When one of these school-boys died, the copies he had written, that could be of no earthly use to any one else, were buried with him. From these old books that he copied he learned to form his own style; he learned the grammar and syntax of his beautiful language; he became acquainted with its vast stock of moral precepts, religious and mythical traditions, and with the unnumbered poems and tales that undoubtedly abounded, and of which the merest fragments have come down to us. Two classes of writings were preferred for this purpose, moral precepts and letters. It was considered absolutely indispensable to inculcate on the minds of the pupils vast numbers of moral precepts. Letter-writing was considered a high and difficult art, and the pupils needed very special preparation in it. Often these copies took the form of correspondence between master and pupil, the letters being sometimes copied from older ones, sometimes invented for the purpose by the teacher. The pupil wrote three pages a day, and the teacher examined his copy with great care, often writing for him the correct form of the letters on the margin, and sometimes expressing his approbation by writing under the copy the word "*nŏfer*"—good. The boys wrote only on one side of the papyrus, often using the other side for rough notes, for first draughts of letters, for practicing more difficult forms of writing; or they drew all sorts of pictures on it, as their fancy dictated.

School was out at noon, but the boy was not then free. He had to assist in the department work all the afternoon, thus learning his duties practically, and being of real use to the government while still a school-boy. The teachers were older officials of the same department, under whose care and instruction the boys were placed, and the same teacher conducted the entire education of a young man, teaching him the first rudiments of writing, initiating him into the practical work of the department, and, even after the young man had become an official himself, remaining his counselor and friend.

Discipline was very strictly maintained. The pupils, who seem to have been entirely under the care of the department, were not allowed to sleep long. Corporal punishment stood in great renown, and the fundamental principle of Egyptian pedagogics was, "The boy has a back; if you beat him on this he will hear." But whipping was not the severest punishment. Specially refractory pupils were bound to the block, and we hear of a youth who suffered this punishment for three months until he was subdued. This strictness is based on a rather curious theory. The argu-

ment is: All animals—horses, lions, dogs, hawks—can be tamed, and a certain animal from Ethiopia can be taught to speak and sing; why can not a young scribe be tamed in like manner? But since men and animals are not exactly one and the same thing, the teachers also used "moral suasion," as we would say. The pupil is constantly pursued with moral precepts and good advice. He is continually admonished to be diligent and obedient, lest he be beaten, for "a boy's ears are situated on his back."

Another principle of Egyptian pedagogics was that the pupils should be but scantily fed. Three rolls and two mugs of beer must suffice for a day, and these the boy's mother brings him every day, and she certainly never forgot to add some slight gift for the teacher. When in the times of the new empire (1530 to 1000 B. C.) Egypt became a military nation, she needed trained officers to lead her troops. These officers were looked upon as officials, as scribes, and their official title was "army-scribes." They were educated in a special school attached to one of the departments, which one we do not know, nor do we know what special course of training they went through.

These schools were maintained by the government for its own purposes; but there was also a large number of theological schools connected with the various temples, and each temple trained up its priests in its own peculiar doctrines. These temple schools seem to have held in ancient Egypt much the same position that the various theological seminaries hold here. There are cases on record showing that young men first graduated from one of the department schools before entering the temple school, and this may have been the regular course.

The ancient Egyptians were acquainted with the sciences of medicine, astronomy, and mathematics, and were good practical engineers and miners. Medicine was, of course, in a very crude and primitive state, though the "Papyrus Ebers" shows some knowledge of anatomy and pathology. Astronomy had been somewhat further advanced. The ancient Egyptians had discovered the zodiac, grouped the stars in constellations, and had devised a means, although crude, of determining the position of the various stars in the heavens; but they seem not to have distinguished the stars from the planets. Their mathematical knowledge was extremely crude and primitive. They could add and subtract, but multiplication and division were very cumbersome, owing to the fact that they could multiply only by 2, and that division resolved itself into the problem of finding by what number the divisor must be multiplied in order to produce the dividend. Of fractions they only knew those whose numerator is 1, except the fraction $\frac{2}{3}$. Geometry and mensuration were also practiced. In their surveys they based their operations on the right-angled triangle.

Of these sciences, medicine and astronomy were probably taught in the temple schools—certainly the former, for all physicians were priests. Engineering and mining were, in all probability, taught practically. Where or how mathematics was taught we do not know. It is, however, a curious fact that while we possess no other Egyptian text-books, we do possess text-books of medicine and mathematics. The great medical "Papyrus Ebers" is a collection of diagnoses and prescriptions calculated to assist the general practitioner as well as to instruct the student. A mathematical text-book has been published by Eisenlohr.

Such is as complete a sketch as can be given of Egyptian education. It is to be borne in mind that it was under control of the government, that it was thoroughly democratic, and that its fundamental principle was utility and its purpose to train scribes, priests, physicians, and officers for the state service, not to form scholars. It is significant in this connection that no mention is made of the education of girls. In the times of the new empire (1530 B. C. and after) we meet with workingmen who are able to read and write, and no doubt the merchants, mechanics, and farmers that composed the wealthy middle class were educated. It may be supposed that the government taught its master workmen to read and write, two accomplishments they needed to properly fulfill their functions; but where and how the merchants, mechanics, and farmers, if they were educated, got their education, we can not even conjecture. The state certainly did not educate them, since it could in its estimate derive no benefit from them, and the idea of popular education never occurred to the state.

THE BRONZE AGE IN SWEDEN.

By W. H. LARRABEE.

BY the Bronze age, Dr. Oscar Montelius * understands that period in the earliest civilization of the Northern races when they made their weapons, tools, etc., of bronze. Besides that composition, they knew only of one metal, gold. The word bronze includes all combinations of copper with tin or zinc, but the usual composition of the articles of this age was ninety parts of copper to ten of tin.

It would be a mistake, however, to refer all antiquities of bronze to the Bronze age. Vessels, rings, buckles, needles, and the like, were still made of bronze after the end of this period, just as they are even in our own day, but generally of a somewhat

* "The Civilization of Sweden in Heathen Times," by Oscar Montelius, Ph. D., with maps and 205 illustrations (New York and London: Macmillan & Co.), whence the materials for this article are derived.

different composition from that which prevailed then. "To this age belong only weapons and edge-tools made of bronze, and such vessels and ornaments as are usually found with them."

Different opinions have been put forward as to the manner in which the Bronze age began in the North. "Some have supposed that it was due to the immigration of a Celtic race, others to a Teutonic immigration. Prof. Nilsson has endeavored to show that the North is indebted to Phœnician colonists for the earliest knowledge of metals; while Herr Wiberg, in Gefle, regarded the Bronze age as having begun in the North through the influence of the Etruscans." Prof. Lindenschmit, of Mainz, who has views of his own respecting the reality of a Northern Bronze age, regards most of the bronze works in question as Etruscan. Dr. Montelius's view is that the beginning of the Bronze age in Scandinavia was not connected with any great immigration of a new race, but that the people of the North learned the art of working in bronze by intercourse with other nations. The "Bronze culture," he thinks, gradually spread itself over the continent of Europe in a northerly and northwesterly direction, until at last it reached the coasts of the Baltic. The end of the Bronze age proper in Scandinavia, when it gave way to the "Iron age," is fixed in the fifth century before the Christian era, when it had lasted about a thousand years. It has been divided into six successive periods. Dr. Montelius does not attempt to distinguish between and describe all of these, but simply makes two general divisions—the earlier and the later Bronze ages.

Fig. 1.—Massive Bronze Axe, with Haft-Hole.

The works of the earlier age are decorated with fine spiral ornaments and zigzag lines, some of which are seen in the axe (Fig. 1), and are associated with the remains of unburned bodies They are distinguished by artistic forms, and point to a highly developed taste, in which they generally surpass the relics of the Bronze age found in other European countries. The works of the later age, of which an illustration is given in the knife (Fig. 2), are characterized by a very different taste and style of ornamentation. Instead of spirals engraved or stamped in the body of the implement, we find the ends of the articles often rolled up in spiral volutes. During this period the dead were always burned. The relative antiquity of burned and

unburned bodies is determined by their relative positions in barrows in which both occur. The burned bodies are always above the unburned ones, showing later deposition.

The large majority of the antiquities belonging to the Swedish Bronze age were of native production. Nearly all the articles of bronze are cast; and traces of the use of the hammer do not appear till near the close of the period. Local styles are observable, so that it is often possible to distinguish with considerable cer-

FIG. 2.—BRONZE KNIFE.

tainty in what part of the North the article was made. Interesting evidences of the home production of these things are often found in the shape of the molds, of stone, in which they were cast, that are occasionally found. A mold of this kind, for casting four saws, is represented in Fig. 3. The presence of unfinished castings, defective specimens, and broken molds, affords sure evidence that the bronze-founding work was done in the country. But "as there are no tin mines in Scandinavia, and the copper mines were probably not worked till more than a thousand years after the end of the Bronze age, we must conclude that the bronze used during this period was imported from foreign countries. Probably it was already mixed, either in the form of works or in bars, because copper and tin in a pure state very seldom occur in the North in finds of this age." Instances of the high perfection which the art of bronze casting had reached are seen in certain large thin bronze vessels cast over a clay core, and a pair of bronze axes with wide-spreading blades consisting of plates of bronze hardly more than the third part of a line in thickness, with the clay core over which they were cast still existing. These axes

FIG. 3.—STONE MOLD FOR CASTING FOUR BRONZE SAWS.

could not have been used as battle-axes, and were too frail to stand the shaking of being carried ceremonially in processions. It is therefore suggested that they were fixed somewhere as standing ornaments. The art of soldering being unknown, joining or repairing was done by pinning the pieces together or by casting bronze over the joint, often in a very clumsy way. Inlaying was practiced, with amber, or with a dark-brown material like resin, which must have produced an effective contrast with the yellow bronze. The art of gilding was not known, but objects were sometimes overlaid with thin plates of gold.

No traces remain of Bronze-age houses, and no representations of them occur among the rock-carvings. The tools were substantially the same as those known to the Stone age, but were more usually—not always—made of bronze. The most common tool was a kind of axe or chisel, known as a "celt." The celts were originally copies of the stone axes, and were "socketed" and not socketed. The socketed celts had a handle inserted into a socket, and were bound to it by a little loop that was provided in the casting. The non-socketed celts were fixed, like the flint axes, into one end of a cloven haft. "Of sewing implements there have been found especially needles, awls, tweezers, and knives. They are almost always of bronze; but a few tweezers and one awl of gold have been found in Sweden and Denmark." The awls were fixed in a haft, of which specimens made of bronze, bone, and amber are preserved. The needles were used in making woolen clothes, and the other implements for sewing leather or skins. Narrow strips or threads of skin were cut out with the knife, holes were bored with the awl, and the leather thread was drawn through the holes with the tweezers. "These implements are much more frequent than the needles, which partially indicates that clothes of skin were far more generally worn than those of wool during this period." Scissors were unknown.

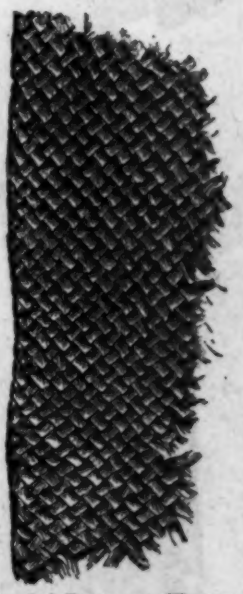

Fig. 4. — Piece of Woolen Stuff of the Bronze Age.

The specimen of woolen cloth represented in Fig. 4 is part of a piece, five feet long and two feet wide, which was found in a barrow at Dömmestorp, in Holland, in 1869, and of which the larger pieces are preserved in the National Museum. It is now brown, and had a yellow border at the narrow ends. A coffin made of a cloven and hollowed trunk of oak, found in the "Treenhoi" barrow at Havdrup, in Denmark, in 1861, contained the

body of a warrior with his clothes well preserved. They consisted of a high cap, a wide, roundly cut mantle, and a sort of tunic, all of woven wool, and two small pieces of wool which are supposed to have covered the legs. At the feet were seen some small remains of leather, which possibly were once shoes. The outside of the cap was covered with projecting pieces of worsted, all ending in a knot, and the inside of the mantle with pendent worsted threads. The tunic was kept together with a long woolen belt, which went twice round in the middle, was knotted in front, and had two long ends hanging down and decorated with fringes. There were also found in the grave a second woolen cap, and a woolen shawl decorated with tassels.

FIG. 5.—WOMAN'S DRESS FROM BORUM-ESHÖI, JUTLAND.

A complete woman's dress (Fig. 5) was found in another Danish barrow, Borum-Eshöi, near Arhus, in Jutland, in 1871. The body had been wrapped in a large mantle, woven with a mixture of wool and cow-hair. The very long hair had probably been fastened up by a horn comb, which was found in the grave. Upon the head was a well-knotted worsted net; and remains of a second similar net were found. The dress consisted of jacket and sleeves, and a long robe, both of woolen stuff, woven in precisely the same way as the clothes found in the graves already described. The jacket was sewed together under the arms and upon the back, and was open in front. The coarse seam on the back showed that it used to be covered by the mantle. The robe was cinctured by two woolen bands, one of coarser and the other of finer work. The latter band, a belt, was of wool and cow-hair mixed, and woven in three rows, of which the middle one seems to have been

of different color from those on the sides. It ended in thick ornamental tassels. A fibula, which may have fastened the jacket or the mantle in front, a spiral finger-ring, two bracelets, a torque, and three round decorated plates with points projecting in the middle, ornaments of the belt, were found in the coffin, and a dagger, the occurrence of which with a woman's body gives the archæologists something to speculate upon. These graves were of the early Bronze age, and are therefore nearly three thousand years old. Both this body and the one in the Treenhoi barrow were inclosed in coffins made of the cloven and hollowed trunk of an oak, and were wrapped in untanned hides.

The ornaments of this age were far more beautiful and varied than those of the Stone age. They were made chiefly of gold and bronze. Amber was more rare than in the Stone age; and silver ornaments and glass do not seem to have yet been known. They included ornaments for the neck and breast, belt ornaments, bracelets, finger-rings, bronze buttons, combs, pendants, and pins. The weapons consisted of daggers, axes, spears, bows and arrows, probably clubs and slings, swords, helmets, and shields. The last were usually of wood or leather, but some of them are very elaborate works of bronze. Representations of helmets appear in the rock-carvings, but an actual specimen—a chin-piece, beautifully decorated and overlaid with gold—of only one has been found. The swords, of which, with daggers of bronze, large numbers have been found in Sweden, were made for thrusting and not for cutting, were short-hilted, and had two-edged and very pointed blades; their sheaths are sometimes unearthed in a more or less complete state of preservation. One is made of wood overlaid with well-tanned leather, and lined with fine skin; others are all wooden, without leather, but sometimes decorated with carved ornaments. Not all of their weapons and tools were of bronze. Flints still continued to be used for the cheaper sorts, and for those most liable to be lost; and bronze seems to have been the mark of a choicer tool, a more favorite weapon, and perhaps of more wealth in the owner.

FIG. 6.—BRONZE SICKLE.

Suggestions of agricultural and pastoral occupations appear in the rock-carvings. One of these sculptures, at Tenegby, in Bohuslän, represents two animals harnessed to a plow and driven by a workman who is walking behind. Another, on one of the re-

markable carved stones of a grave at Kivik, shows a two-wheeled chariot, with two horses, and a driver standing upon it. Bits and bridles of nearly the same kind as those used now have been

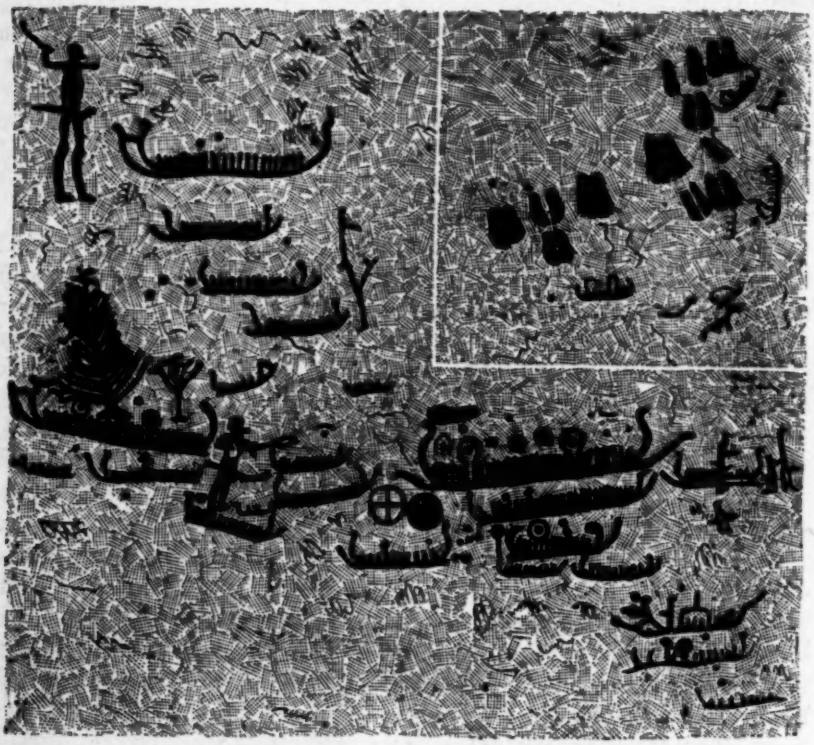

FIG. 7.—ROCK-CARVING IN LÖKEBURG IN BOHUSLÄN.

found; and the bones of domestic animals and hides—both tanned and untanned—of oxen and cows, are common.

Shapely bronze sickles (Fig. 6) and hand-mills attest to a sys-

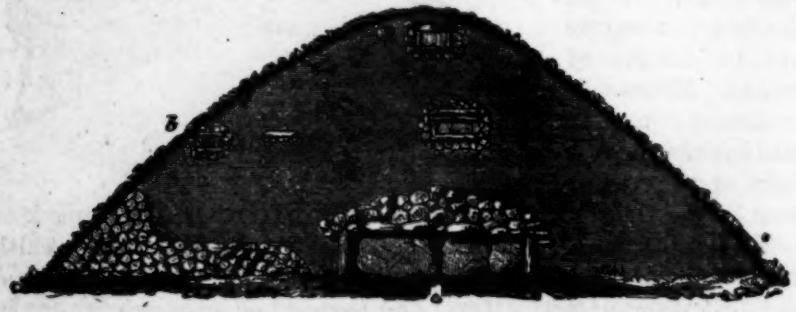

FIG. 8.—SECTION OF A BARROW AT DÖMMESTORP IN SOUTH HOLLAND.

tematic cultivation of grain. "Tillage," Prof. Montelius adds "necessarily presupposes fixed dwelling-places; that these existed

is further made probable by the fact that the barrows of the period so often lie thick together."

While writing was unknown during the Bronze age, a sort of picture-writing existed which is preserved in the rock-carvings found quite often in different parts of the country. There can hardly be a question of the age of these works, for the representations of swords and other known objects correspond closely with the objects themselves that remain; and the absence of Runic or other inscriptions in connection with them forbids the presumption of their belonging to a later age than that of bronze. The pictures do not indicate much artistic power in the carvers, but they furnish useful clews to the kind of life the people led and the trend of their thoughts. Thus, besides illustrating the use of horses and oxen, they tell us of the appearance and size of the boats (Fig. 7), of which no actual specimens that can be certainly assigned to the Bronze age have yet been found. These vessels seem to have been usually, but not always, alike at the two ends. "We often see the high and narrow stem terminating in an animal's head; sometimes the stern also is similarly decorated. As no indisputable traces of masts and sails have been found on the rock-carvings, the boats of the Bronze age would seem to have been exclusively designed for rowing. The same is also the case . . . with the remarkable boat found in the bog at Nydam, in Denmark, which belongs to an early part of the Iron age. We often find sea-fights described on the rock-carvings. We have also proofs of peaceful intercourse by sea with other peoples in the many things imported from foreign lands which occur in the finds from the Bronze age. Chief among imported goods we must reckon all the bronze used in Sweden at this time regarded as raw material. Probably also most of the gold used there during the Bronze age was brought from other countries. Besides these, we ought also to set down as imports certain bronze works which are undoubtedly of foreign origin, because they are very rare in Scandinavia but common in other countries."

The dead were buried unburned in the earlier and burned in the later part of the Bronze age. The unburned bodies were usually laid in cists composed of flat stones placed edgewise, and covered with similar stones. Coffins made of oak trunks split and hollowed out are not uncommon. The stone cists, which contain several skeletons, and are often very large, appear to be the oldest; others are smaller, and contain a single extended skeleton. Sometimes the bones do not lie immediately in the small stone cists, but in an earthenware vessel, which may be closely surrounded by the stones of the cist, or may be without a cist. Sometimes, again, graves of the Bronze age are made up entirely of collections of burned bones lying buried in the ground and only covered by a flat

stone, as in Fig. 8.* The burial-places "thus form a gradual transition from the great grave chambers, and the stone cists with their many skeletons, of the Stone age on the one side, to the insignificant grave with burned bones at the end of the Bronze age on the other." The graves were usually covered with a barrow, and this often contained several stones. The barrows are generally situated upon some height which commands an unimpeded view over the sea or some large lake. Weapons, ornaments, and vessels of earthenware or wood are often found by the remains of the dead.

The author believes, from the evidence of the finds lately made in that land, that the condition of Greece during its Bronze age was in many ways like that of the North during the same stage of its civilization; and that probably Homer's description of the heroic age of Greece would in more than one respect apply to the south of Scandinavia three thousand years ago—"at least if we do not allow our eyes to be dazzled by the poetic shimmer which hangs around the heroes of the Trojan war." But the Bronze age both began and ended in Greece earlier than in the North. There are also other countries in which the Bronze age ended later than in Scandinavia. Of these was Mexico, when the Spaniards entered upon the conquest of it. And yet in many respects, the author remarks, the civilization of the Aztecs was "as high as that of which Europe could boast in the middle ages." He expresses no inference from this remark, but presumably expects us to draw one that the Scandinavians of the Bronze age were possibly not so barbarous as we assume that they were.

ANTHROPOLOGY AT WASHINGTON.

By Prof. J. HOWARD GORE.

THE early voyagers to America, coming from the civilized countries of Europe, were perhaps more surprised at the native inhabitants whom they found than at the broad rivers, boundless forests, or vast plains. The Indians, with their curious customs and various costumes, produced dissimilar impressions upon their different beholders. But all found that the most interesting portions of the reports which they sent back to their homes were the descriptions of the strange people whom they had seen; the report being in some cases accompanied with specimens

* In the middle of the bottom of this barrow was a stone cist nearly seven feet long (*a*), containing an unburned body and a bronze pin. Higher up were found three small stone cists containing burned bones and antiquities of bronze. Close by the little cist at the top of the barrow stood a vessel filled with burned bones, and near the cist, marked *b*, lay a heap of burned bones, covered only by a flat stone.

of their handiwork, and in a few cases by living captives. The stimulated curiosity regarding America, and the feeling that there could be nothing too unusual to come from this almost fabulous land, prompted men to weave a large amount of fiction into their statements concerning the people of the New World, and by skillful alterations to make the work of these savages appear more startling or ingenious. Hence, many early books describing the aborigines of America are of no value, and the illustrations of industrial arts are unreliable. The meeting with new customs did not cease with the thorough acquaintance with the first tribe who greeted the foreigners, nor was all of interest known at the time when an independent government was established for the infant colonies. Almost each day's journey westward brought the explorer, if not into the center of a new tribe, at least into a new community, whose customs differed from those of the people who had surrounded him the day before. Should the wanderer be permitted to return to the seat of his government, his tales of strange scenes and adventures would be listened to with as much interest as the Spanish or English reader had given to the written stories a century previous. Thus, during the most advantageous period for careful observation of the unaffected customs of the Indians, the visitors were hunters or traders who used their opportunities in collecting miraculous stories for the ears of those who awaited their return, and the number of such stories required of each new one, as the price of its acceptance, that it be more exciting than its predecessors.

When an intelligent foresight suggested the systematic exploration of new territories, the first step was taken in the establishment of institutions which are now the pride of America. Though it was the desire to know more of the mineral and agricultural resources of the undiscovered portions of our country that started the first expeditions westward, still the intelligent men who were in charge brought back much of interest and value to the ethnologist. These expeditions increased in number and usefulness, and their reports are still sources of interesting information. The objects which were brought back to serve as models for the illustrations soon formed a nucleus for collections which are now studied by anthropologists of all countries.

The wisdom of investigating the customs of the Indians of North America, and of preserving specimens of their work, has made itself so apparent that we have in the United States three institutions doing more toward collecting information about its native people than is or has been done by any other country of the world. These are, the Smithsonian Institution and the allied National Museum, the Bureau of Ethnology, and the Army Medical Museum.

THE SMITHSONIAN INSTITUTION AND THE NATIONAL MUSEUM.—The will of Smithson in founding this institution contained but one proviso regarding its organization, that it was to be "for the increase and diffusion of knowledge." The museum feature was purely incidental: specimens were sent, accompanying questions that were addressed to the institution; they were preserved, and with the collection of birds brought by Baird from the Pacific Railroad expedition formed the beginning of a museum. These objects, growing rapidly in number at the return of each expedition, were taken care of in the Smithsonian building, until the large gifts received from many foreign governments and private exhibitors at the Centennial Exposition in 1876 made it necessary to erect a separate building, which is now known as the National Museum.

Prof. Goode, who was wisely placed in charge of the collection, secured at once the assistance of volunteer curators to supplement the museum staff, and with their co-operation elaborated and perfected a scheme which may be called, in its fruition, an Anthropological Kindergarten. Prof. Goode considers as the central point Man, and aims to illustrate as far as possible the development of everything that contributes to his welfare, comfort, or amusement, that is hurtful or beneficial to him, or that affects his moral or æsthetic nature. No monstrosity finds a place, nor does any object of sentimental association receive a welcome.

The first successful attempt to embrace the whole science of anthropology under one systematic classification was made by Prof. O. T. Mason. Its adoption as the basis for the Smithsonian exhibit at the Centennial gave to it the importance it deserves. It is, with such modifications as its practical application have suggested, now followed in the National Museum, where Prof. Mason has charge of the department of anthropology, and has given to the Anthropological Society of Washington its principal divisions.

The science of anthropology is now divided between the National Museum and the Army Medical Museum, in contiguous buildings, as follows: All specimens belonging to the biological side of the science, collected by the National Museum, are placed in the Army Medical Museum. This includes anatomy, physiology, embryology, anthropometry, and kindred topics.

On the other hand, all specimens illustrative of languages, arts, sociology, customs, beliefs, etc., of man, gathered by the army, are deposited in the National Museum. In this way, the two institutions work in harmony, and do not duplicate each other's work.

The division of anthropology in the National Museum is organized into departments of the ARTS AND INDUSTRIES OF MANKIND, in which are included, in their several sections, medicinal

plants; foods and textiles; fisheries (showing methods of taking and utilizing marine animals); naval architecture (starting with the bark boat, the skin boat, the raft, and the dug-out, and tracing the evolution of naval architecture to the ocean steamer); graphic arts; history and numismatics; and land transportation (beginning with the simplest device for locomotion and transportation, and ending with the railroad);—ETHNOLOGY, in which is included the fullest collection of American pottery in the world;—and PREHISTORIC ARCHÆOLOGY, in a magnificent collection, occupying the entire upper story of the Smithsonian building. The American portion was classified by the late Dr. Charles Rau. The European collection, founded by Mr. Thomas Wilson, is arranged according to the chart of De Mortillet.

As avenues of publication the Museum has the "Reports," "Miscellaneous Collections," and "Contributions" of the Smithsonian Institution, and its own "Proceedings," "Bulletin," and "Transactions."

For obtaining collections, it relies upon gifts and deposits, which are often very liberal; the material collected by officers of the army and navy, Hydrographic Bureau, Coast Survey, Geological Survey, Bureau of Ethnology, consular service, etc., which are given to it by law; gifts turned over by public expositions and fairs at their close; and international exchanges. The material thus accruing is received as fast as the staff of the Museum can attend to it.

THE BUREAU OF ETHNOLOGY.—The bureau, as at present constituted, was organized in 1879, when an appropriation of twenty-five thousand dollars was made by Congress for "the prosecution of ethnologic researches among the North American Indians." During each of the succeeding years an equal or larger appropriation has been made, the amount up to the present time aggregating three hundred thousand dollars. This amount has been expended for field and office work. The force officially connected with the bureau, and constituting its staff of workers, consists of specialists trained in the several lines of research, each working independently in his own field, but each giving assistance, and receiving assistance from every other, as the lines of investigation touch and overlap each other. The whole is under the direction of Major J. W. Powell. Results of great value are derived by stimulating and guiding research on the part of collaborators in different parts of the country who are not officially connected with the bureau.

Of the researches at present conducted by the bureau, the most important are probably those in linguistics. Owing to the breaking up of the tribal system and the consolidation of the smaller with the larger tribes, to the adoption by the Indians of

civilized manners and pursuits, and to the extinction in some portions of the country of the language with the Indians who spoke them, the Indian languages are fast disappearing from the face of the earth. Accordingly, a large share of the time and labor of the bureau force has been, and will continue to be, devoted to the record and preservation of aboriginal languages. Each year one or more trained linguistic scholars are dispatched to remote parts of the country, charged, as their prime duty, with the task of collecting as much as possible of the speech of obscure tribes. To facilitate their work, and to aid and encourage linguistic students in all portions of the country, a special work has been prepared by the director, entitled "Introduction to the Study of Indian Languages."

Comparatively little time can be devoted at present to the analysis and study of the languages collected. The pressing need of the moment is their preservation for the use and study of future scholars. Nevertheless, the study is by no means wholly neglected, as will be apparent from the fact that monographs are now being prepared upon the Dakota languages, by J. Owen Dorsey; upon the Klamath language, by A. S. Gatschett; upon the Tuscarora language, by J. N. B. Hewitt; and upon Cherokee, by James Mooney.

Much has been accomplished in the direction of a comparison of vocabularies and the classification of the tribes by language. A book embodying the final results of this study, by Major Powell, which has been many years in progress, will soon appear. The number of distinct linguistic families occupying the territory north of Mexico at the time of the discovery was, so far as known, sixty, while the languages included in these probably numbered not less than three hundred. A colored map has been completed, and is now ready for publication, setting forth the areas occupied by the linguistic families.

Another important work, now far advanced toward completion, is a "Dictionary of Tribal Names," in charge of Mr. H. W. Henshaw. In this will be assembled, under each of the linguistic families, all the tribes composing it. Short, succinct historical and descriptive accounts will appear under the head of each family and tribe, while cross-references will refer to the proper names of each tribe the vast body of synonyms which have crept into literature since the earliest published accounts. It is calculated that the above material will fill a volume of about one thousand pages.

MOUNDS.—The important work of the exploration of the mounds east of the Mississippi Valley is under the charge of Cyrus Thomas, whose investigations cover a period of six years. The first of the three volumes which will contain his final report is now ready for the press. A very large number of mounds in several States

have been surveyed, photographed, and explored, with a view to ascertain their nature, purposes, and contents, and a considerable body of facts pertaining thereto has been gathered.

RUINS.—Aboriginal remains of this class are chiefly confined to the Territories of Arizona and New Mexico. Their examination is in charge of Victor Mindeleff, who is now preparing an extensively illustrated work upon them. Each visit to these regions results in the discovery of hitherto unknown groups of these interesting ruins. A large number have been photographed and surveyed so carefully that models of many of them have been made to a scale, and are now on exhibition in the National Museum. Careful examination of the methods of architecture of the ruins connects them closely with the existing *pueblos*, among the present inhabitants of which indeed have been found exact traditions of the former occupancy of these ruins by their ancestors, while the causes that led to their abandonment are often known.

SIGN-LANGUAGE AND PICTOGRAPHY.—The collection and study of the material for a monograph on these subjects is in charge of Colonel Garrick Mallery. Nowhere, perhaps—at least in modern times—has the sign-language been so extensively used as in America. The collection of the gestures employed in different parts of the country, and their comparison with those used in other parts of the world, have involved great labor, but are now nearly completed. The study of pictographs is a natural correlative to that of gesture-language, the latter being an earlier form of the preceding. Various portions of the United States have been visited, and a large number of pictographs have been photographed or sketched. These occur in the form of petroglyphs or rock-carvings, of paintings on the hides of animals, and etchings on birch-bark. Colonel Mallery's final report upon the above subject may be looked for at no distant day.

MYTHOLOGY.—The number of myths current among any one Indian tribe is surprising; and, as they differ to a greater or less degree even among tribes of the same locality and are quite distinct in different regions, their total number in the country at large is enormous. As ideas of a religious or superstitious character are known to be very enduring, it has been thought by some that myths may prove an important adjunct in the work of classifying tribes. They are also important as constituting the philosophy of savagery and barbarism, and by their study we arrive more closely than in any other way at primitive ideas of the nature of things, of the forces of nature, and of primitive methods of reasoning. No opportunity has been lost by the bureau assistants to collect Indian myths in their purity, and a vast body of them are now awaiting study.

PHOTOGRAPHY.—The director of the bureau has been fully

alive to the importance of recording the physical appearance, features, and methods of dress of the Indian in his primitive condition, and to this end full use has been made of the camera. The collection of photographs of Indians from all parts of the country, taken either in their homes or upon the occasion of their periodical visits to Washington, is now very large, and constitutes a body of ethnologic material, the value of which it would be difficult to overestimate.

ARTS AND CUSTOMS.—Although the rapid settlement of the country, and the introduction of habits and implements of civilization, have effected great change in the arts and customs of the Indians, yet among many tribes the old ways of life have been by no means abandoned, and primitive habits and modes of thought still flourish. Investigators sent out by the bureau are required to note the details of the every-day life of the Indians, and to describe such of their primitive arts as still survive as well as those that are borrowed from civilization and modified in accordance with the Indian ideas. Especial attention has been paid to their mechanical operations and appliances, particularly to the making of pottery and textile fabrics, to the ideas and methods of medicinal practice, etc. Here, again, photography has done good work in retaining, uninfluenced by a writer's subsequent imagination, the exact method of using the different implements and materials. Very large collections of pottery, clothing, and implements of various sorts have been made and are deposited in the National Museum.

Of the publications of the bureau the annual reports consist of an account of the current year's operations by the director, together with papers upon a variety of topics by the bureau assistants and by collaborators. These reports are usually liberally illustrated, and are intended to include subjects of a popular character, or those which from their nature are likely to interest a large class of readers. Up to the present time four volumes of the reports have appeared, and the matter for Vol. V is ready.

The contributions to North American ethnology are quarto volumes appearing at irregular intervals, and are in the nature of monographs upon special subjects, to which many of the papers in the annual reports are preliminary. They constitute the most important series published by the bureau, and contain the ripened studies of the scholars by whom they were written. Of these, three volumes have appeared, and two are ready for the press. A third class of publications embraces the bulletins which are intended to be the vehicle of publication of short articles upon various subjects, the speedy appearance of which is desired. So far five such bulletins have been published.

During the progress of investigations, which are ultimately to

be published in the form of monographs, it is the custom to issue, as widely as occasion requires, circulars intended to call attention to special subjects being investigated, and to invite correspondence and to elicit information from specialists and investigators in all parts of the world. Occasionally the importance of the subject has warranted the issuance of such documents in the form designed for the finished work, with the view of setting forth the facts gathered and the progress made in the study. The latter publications, however, are looked upon only in the nature of proof-sheets, being intended for the temporary use of collaborators, and are to be recalled and destroyed when the final reports are published.

THE ARMY MEDICAL MUSEUM.—The anthropological investigations which are fostered by this institution are on the biological side. The large collections of skeletons, and especially of crania, make it possible to secure valuable data in anthropometry. Drs. Billings and Matthews have been alive to the richness of the material at their disposal, and their studies in skull measurements and composite photography of crania will be among the most valuable contributions of the United States Government to anthropology.

It is not surprising that with the large number of anthropologists, together with such other students as the public and private institutions at Washington contain, a prosperous Anthropological Society should be in operation. This society, organized in 1879, now has an active membership of sixteen hundred. Of the two hundred and more papers that have been presented, more than half were by persons who were in the institutions already described. Four volumes of "Transactions" have been published, and the society is now issuing a quarterly of ninety-six pages.

The following are the titles of the principal papers in the publications of the Bureau of Ethnology:

ANNUAL REPORTS.

Vol. I, Washington, 1881:

1. "On the Evolution of Language," by J. W. Powell.

2. "Sketch of the Mythology of the North American Indians," by J. W. Powell.

3. "Contribution to the Study of the Mortuary Customs of the North American Indians," by Dr. H. C. Yarrow.

4. "Studies in Central American Picture-Writing," by E. S. Holden.

5. "Cessions of Land by Indian Tribes to the United States," by C. C. Royce.

6. "Sign-Language among North American Indians compared with that among other Peoples and Deaf-Mutes," by Garrick Mallery.

Vol. II, 1883:

1. "Zuñi Fetiches," by F. H. Cushing.

2. "Myths of the Iroquois," by E. A. Smith.

3. "Animal Carvings from Mounds of the Mississippi Valley," by H. W. Henshaw.

4. "Navajo Silversmiths," by Dr. W. Matthews.

5. "Art in Shell of the Ancient Americans," by W. H. Holmes.

Vol. III, 1888:

1. "Notes on Certain Maya and Mexican Manuscripts," by Cyrus Thomas.

2. "Masks, Labrets, and Certain Aboriginal Customs," by W. H. Dall.

3. "Omaha Sociology," by J. O. Dorsey.

4. "Navajo Weavers," by Dr. W. Matthews.

5. "Prehistoric Textile Fabrics of the United States derived from Impressions on Pottery," by W. H. Holmes.

Vol. IV, 1886:

1. "Pictographs of the North American Indians: a Preliminary Paper," by Garrick Mallery.

2. "Pottery of the Ancient Pueblos," by W. H. Holmes.

3. "Ancient Pottery of the Mississippi Valley," by W. H. Holmes.

4. "Origin and Development of Form and Ornament in Ceramic Art," by W. H. Holmes.

5. "A Study of Pueblo Pottery as illustrating Zuñi Culture-Growth," by F. H. Cushing.

Vol. V, 1887:

1. "Burial Mounds of the Northern Section of the United States," by Cyrus Thomas.

2. "The Cherokee Nation of Indians," by C. C. Royce.

3. "The Mountain Chant; a Navajo Ceremony," by Dr. W. Matthews.

4. "The Seminole Indians of Florida," by Clay Maccauley.

5. "The Religious Life of the Zuñi Child," by Mrs. T. E. Stevenson.

CONTRIBUTIONS TO NORTH AMERICAN ETHNOLOGY.

Vol. I, Washington, 1877:

1. "Tribes of the Extreme Northwest," by W. H. Dall.

2. "Tribes of Western Washington Territory and Northwestern Oregon," by George Gibbs.

Vol. II. Not published.

Vol. III, 1877:

"Tribes of California," by Stephen Powers, with an Appendix on Linguistics, by J. W. Powell.

Vol. IV, pp. xi–281, Washington, 1881.

"Houses and House-Life of the American Aborigines," by Lewis Morgan.

Vol. V, 1882:

1. "Observations on Cup-shaped and other Lapidarian Sculpture in the Old World and in America," by C. Rau.

2. "On Prehistoric Trephining and Cranial Amulets," by Robert Fletcher.

3. "A Study of the Manuscript Troano," by Cyrus Thomas.

BULLETINS.

1. "Ancient Inhabitants of Chiriqui, Isthmus of Darien," by W. H. Holmes. Pp. 27, 22 cuts. Washington, 1887.

2. "Work in Mound Exploration of the Bureau of Ethnology," by Cyrus Thomas. Pp. 13. Washington, 1887.

3. "Perforated Stones from California," by H. W. Henshaw. Pp. 34, 16 cuts. Washington, 1887.

4. "Bibliography of the Eskimo Language," by J. C. Pilling. Pp. v–115. Washington, 1887.

5. "Bibliography of the Siouan Language," by J. C. Pilling. Pp. v–87. Washington, 1887.

6. "Indian Textile Fabrics of Ancient Peru," by W. H. Holmes.

7. "Problems of the Ohio Mounds," by Cyrus Thomas.

8. "Bibliography of the Iroquoian Language," by J. C. Pilling.

The three by J. C. Pilling are separate and extended parts of a work which Mr. Pilling first published as proof-sheets of a "Bibliography of the Languages of the North American Indians."

DIGESTION AND RELATED FUNCTIONS.*

By WESLEY MILLS, M. D.,

PROFESSOR OF PHYSIOLOGY IN MCGILL UNIVERSITY.

IT is a matter well recognized by those of much experience in breeding and keeping animals with restricted freedom and under other conditions differing widely from the natural ones—i. e., those under which the animals exist in a wild state—that the nature of the food must vary from that which the untamed ancestors of our domestic animals used. Food may often with advantage be cooked for the tame and confined animal. The digestive and the assimilative powers have varied with other changes in the organism brought about by the new surroundings. So much is this the case, that it is necessary to resort to common experience and to more exact experiments to ascertain the best methods of feeding animals for fattening, for work, or for breeding. Inferences drawn from the feeding habits of wild animals allied to the tame to be valuable must always, before being applied to the latter, be subjected to correction by the results of experience.

To a still greater degree does this apply to man himself. The greater his advances in civilization, the more he departs from primitive habits in other respects, the more must he depart in his feeding. With the progressive development of man's cerebrum, the keener struggle for place and power, the more his nervous energies are diverted from the lower functions of digestion and assimilation of food; hence the greater need that food shall be more carefully selected and more thoroughly and scientifically prepared. Not only so, but, with our increasing refinement, the progress of digestion to successful issues demands that the senses of man be ministered to in order that there be no interferences in the central nervous system, and every encouragement given to

* From advance sheets of a text-book on "Animal Physiology" in press of D. Appleton & Co.

the latter to furnish the necessary nervous impulses to the digestive organs and the tissues in every part of the organism: for it is not enough that food be digested in the ordinary sense; it must also be built up into the tissues, a process depending, as we shall endeavor to show later, on the nervous system.

The "gastronomic art" has, therefore, become of great importance. It is as yet more of an art than a science; the cook has outstripped the physiologist, if not the chemist also, in this direction.

We can not explain fully why food prepared by certain methods and served in courses of a certain established order is so suited to refined man. A part is known, but a great deal remains to be discovered. We may, however, notice a few points of importance in regard to the preparation of food.

It is now well established by experience that animals kept in confinement must have, in order to escape disease and attain the best results on the whole, a diet which not only imitates that of the corresponding wild forms generally, but even in details, it may be, with altered proportions or added constituents, in consequence of the difference in the environment. To illustrate: poultry can not be kept healthy confined in a shed without sand, gravel, old mortar, or some similar preparation; indeed, for the best results they must have green food also, as lettuce, cabbage, chopped green clover, grass, etc. They do not require as much food as if they had the exercise afforded by running hither and thither over a large field. We have chosen this example because it is not commonly recognized that our domesticated birds have been so modified that special study must be made of the environment in all cases if they are not to degenerate. The facts in regard to horned cattle, horses, and dogs are perhaps better known.

But all these instances are simple as compared with man. The lower mammals can live and flourish with comparatively little change of diet; not so man. He demands food not only dissimilar in its actual grosser nature, but differently prepared. In a word, for the efferent nervous impulses, on which the digestive processes depend, to be properly supplied, it has become necessary that a variety of afferent impulses (through eye, ear, nose, palate) reach the nervous centers, attuning them to harmony, so that they shall act, yet not interfere with one another.

Cooking greatly alters the chemical composition, the mechanical condition, and, in consequence, the flavor, the digestibility, and the nutritive value of foods. To illustrate: meat in its raw condition would present mechanical difficulties, the digestive fluids permeating it less completely; an obstacle, however, of far greater magnitude in the case of most vegetable foods. By cooking, certain chemical compounds are replaced by others, while some may be wholly removed. As a rule, boiling is not a good form of pre-

paring meat, because it withdraws not only salts of importance, but proteids and the extractives—nitrogenous and other. Beef-tea is valuable chiefly because of these extractives, though it also contains a little gelatin, albumin, and fats. Salt meat furnishes less nutriment, a large part having been removed by the brine; notwithstanding, all persons at times, and some frequently, find such food highly beneficial, the effect being doubtless not confined to the alimentary tract.

Meat, according to the heat employed, may be so cooked as to retain the greater part of its juices within it or the reverse. With a high temperature (65° to 70° C.) the outside in roasting may be so quickly hardened as to retain the juices.

In feeding dogs it is both physiological and economical to give the animal the broth as well as the meat itself. The poor man may get excellent food cheaply by using not alone the meat of the shank of beef, but the soup (extractives) derived from it. There is much waste not only by the consumption of more food than is necessary, but by the purchase of kinds in which that important class, the proteids, comes at too high a price.

It is remarkable in the highest degree that man's appetite, or the instinctive choice of food, has proved wiser than our science. It would be impossible even yet to match, by calculations based on any data we can obtain, a diet for each man equal upon the whole to what his instincts prompt. With the lower mammals we can prescribe with greater success. At the same time chemical and physiological science can lay down general principles based on actual experience, which may serve to correct some artificialities acquired by perseverance in habits that were not based on the true instincts of a sound body and a healthy mental and moral nature; for the influence of the latter can not be safely ignored even in such discussions as the present. These remarks, however, are meant to be suggestive rather than exhaustive.

We may with advantage inquire into the nature of hunger and thirst. These, as we know, are safe guides usually in eating and drinking.

After a long walk on a warm day one feels thirsty; the mouth is usually dry; at all events, moistening the mouth, especially the back of it (pharynx), will of itself partially relieve thirst. But if we remain quiet for a little time the thirst grows less, even if no fluid be taken. The dryness has been relieved by the natural secretions. If, however, fluid be introduced into the blood either directly or through the alimentary canal, the thirst is also relieved speedily. The fact that we know when to stop drinking water shows of itself that there must be local sensations that guide us, for it is not possible to believe that the whole of the fluid taken can at once have entered the blood.

Again, in the case of hunger, the introduction of innutritious matters, as earth or sawdust, will somewhat relieve the urgent sensations in extreme cases, as will also the use of tobacco by smokers, or much mental occupation, though this is rather illustrative of the lessening of the consciousness of the ingoing impulses by diverting the attention from them. But hunger, like thirst, may be mitigated by injections into the intestines or the blood. It is, therefore, clear that, while in the case of hunger and thirst there is a local expression of a need, a peculiar sensation, more pronounced in certain parts (the fauces in the case of thirst, the stomach in that of hunger), yet these may be appeased from within through the medium of the blood, as well as from without by the introduction of food or water, as the case may be.

Up to the present we have assumed that the changes wrought in the food in the alimentary tract were identical with those produced by the digestive ferments as obtained by extracts of the organs naturally furnishing them. But for many reasons it seems probable that artificial digestion can not be regarded as parallel with the natural processes except in a very general way. When we take into account the absence of muscular movements, regulated according to no rigid principles, but varying with innumerable circumstances in all probability, the absence of the influence of the nervous system determining the variations in the quantity and composition of the outflow of the secretions; the changes in the rate of so-called absorption, which doubtless influences also the act of the secretion of the juices—by these and a host of other considerations we are led to hesitate before we commit ourselves too unreservedly to the belief that the processes of natural digestion can be exactly imitated in the laboratory.

What is it which enables one man to digest habitually what may be almost a poison to another? How is it that each one can dispose readily of a food at one time that at another is quite indigestible? To reply that, in the one case, the digestive fluids are poured out and in the other not, is to go little below the surface, for one asks the reason of this, if it be a fact, as it no doubt is. When we look further into the peculiarities of digestion, etc., we recognize the influence of race as such, and in the race and the individual that obtrusive though ill-understood fact—the force of *habit*, operative here as elsewhere. And there can be little doubt that the habits of a people, as to food eaten and digestive peculiarities established, become organized, fixed, and transmitted to posterity.

It is probably in this way that, in the course of the evolution of the various groups of animals, they have come to vary so much in their choice of food and in their digestive processes, did we but know them thoroughly as they are; for to assume that even the

digestion of mammals can be summed up in the simple way now prevalent seems to us too broad an assumption. The field is very wide, and as yet but little explored.

HUMAN PHYSIOLOGY.—The study of Alexis St. Martin has furnished probably the best example of genuine human physiology to be found, and has yielded a harvest rich in results.

We suggest to the student that self-observation, without interfering with the natural processes, may lead to valuable knowledge; for, though it may lack some of the precision of laboratory experiments, it will prove in many respects more instructive, suggestive, and impressive, and have a bearing on medical practice that will make it telling. Not that we would be understood now or at any time as depreciating laboratory experiments, but we wish to point out from time to time how much may be learned in ways that are simple, inexpensive, and consume but little time.

The law of rhythm is illustrated, both in health and disease, in striking ways in the digestive tract. An individual long accustomed to eat at a certain hour of the day will experience at that time not only hunger, but other sensations, probably referable to secretion of a certain quantity of the digestive juices and to the movements that usually accompany the presence of food in the alimentary tract. Some persons find their digestion disordered by a change in the hours of meals.

It is well known that defecation at periods fixed, even within a few minutes, has become an established habit with hosts of people; and the same is to a degree true of dogs, etc., kept in confinement, taught cleanly habits, and encouraged therein by regular attention to their needs.

Now and then a case of what is very similar to regurgitation of food in ruminants is to be found among human beings. This is traceable to habit, which is bound up with the law of rhythm or periodic increased and diminished activity.

Indeed, every one sufficiently observant may notice in himself instances of the application of this law in the economy of his own digestive organs.

This tendency is important in preserving energy for higher ends, for such is the result of the operation of this law everywhere.

The law of correlation, or mutual dependence, is well illustrated in the series of organs composing the alimentary tract.

The condition of the stomach has its counterpart in the rest of the tract: thus, when St. Martin had a disordered stomach, the epithelium of his tongue showed corresponding changes.

We have already referred to the fact that one part may do extra work to make up for the deficiencies of another.

It is confidently asserted of late that, in the case of persons

long unable to take food by the mouth, nutritive substances given by enemata find their way up to the duodenum by antiperistalsis. Here, then, is an example of an acquired adaptive arrangement under the stress of circumstances.

It can not be too much impressed on the mind that in the complicated body of the mammal the work of any one organ is constantly varying with the changes elsewhere. It is this mutual dependence and adaptation—an old doctrine, too much left out of sight in modern physiology—which makes the attempt to *completely* unravel vital processes well-nigh hopeless, though each accumulating true observation gives a better insight into this kaleidoscopic mechanism.

We have not attempted to make any statements as to the quantity of the various secretions discharged. This is large, doubtless, but much is probably reabsorbed, either altered or unaltered, and used over again. In the case of *fistulæ* the conditions are so unnatural that any conclusions as to the normal quantity from the data they afford must be highly unsatisfactory. Moreover, the quantity must be very variable, according to the law we are now considering. It is well known that dry food provokes a more abundant discharge of saliva, and this is doubtless but one example of many other relations between the character of the food and the quantity of secretion provided.

EVOLUTION.—We have from time to time either distinctly pointed out or hinted at the evolutionary implications of the facts of this department of physiology. The structure of the digestive organs, plainly indicating a rising scale of complexity with greater and greater differentiation of function, is, beyond question, an evidence of evolution.

The law of natural selection and the law of adaptation, giving rise to new forms, have both operated, we may believe, from what can be observed going on around us and in ourselves. The occurrence of transitional forms, as in the epithelium of the digestive tract of the frog, is also in harmony with the conception of a progressive evolution of structure and function. But the limits of space will not permit of the enumeration of details.

SUMMARY.—A very brief *résumé* of the subject of digestion will probably suffice.

Food is either organic or inorganic, and comprises proteids, fats, carbohydrates, salts, and water; and each of these must enter into the diet of all known animals. They must also be in a form that is digestible. Digestion is the reduction of food to a form such that it may be further dealt with by the alimentary tract prior to being introduced into the blood (absorption). This is effected in different parts of the tract, the various constituents of food being differently modified, according to the secretions there

provided, etc. The digestive juices contain essentially ferments which act only under definite conditions of chemical reaction, temperature, etc.

The changes wrought in the food are the following: Starches are converted into sugars, proteids into peptones, and fats into fatty acids, soaps, and emulsion; which alterations are effected by ptyalin and amylopsin, pepsin and trypsin, and bile and pancreatic steapsin, respectively.

Outside the mucous membrane containing the glands are muscular coats, serving to bring about the movements of the food along the digestive tract and to expel the fæces, the circular fibers being the more important. These movements and the processes of secretion and so-called absorption are under the control of the nervous system.

The preparation of the digestive secretions involves a series of changes in the epithelial cells concerned, which can be distinctly traced, and takes place in response to nervous stimulation.

These we regard as inseparably bound up with the healthy life of the cell. To be natural, it must secrete.

The blood-vessels of the stomach and intestine and the villi of the latter receive the digested food for further elaboration (absorption). The undigested remnant of food and the excretions of the intestine make up the fæces, the latter being expelled by a series of co-ordinated muscular movements essentially reflex in origin.

THE CHEMIST AS A CONSTRUCTOR.

By W. BERNHARDT.

ONE of the most attractive branches of modern chemistry comprises the artificial preparation of compounds existing preformed in nature, or, in other words, the imitation of the works of creative power. Synthesis, as this section of chemical investigation is called, although it has already attained a considerable degree of success, is of but recent origin compared with analysis, or those researches by which we become acquainted with the composition of the products of nature, and of what we derive from them by industrial processes. It is an indispensable condition, before learning how to compound a body, to know what are its constituents, what their properties are, and by what agents they are most liable to be brought into combination with each other. Therefore, synthetical processes could only be founded upon the results of analytical investigations. It is chiefly to the thorough knowledge of the properties and affinities of the seventy so-called elements that we owe the innumerable discoveries which

have raised chemistry to its present important position, together with the insight into the manifold changes and metamorphoses which terrestrial matter has undergone in past times, and which it still undergoes, and into the processes active in vegetable and animal organisms.

The events preceding the discovery of the composition of water afford a striking instance of how many difficulties had to be overcome from the very first observations on the chemical nature of this body—ubiquitous on the surface of the earth—to the ascertainment of its composition, and to our ability voluntarily to prepare it. In the middle ages the doctrine of Aristotle was predominant, that all matter consisted of four elements—air, fire, earth, and water—difference in properties being ascribed only to the varying proportions in which these elements were present. Not much more was known of its physical and chemical characters, but that it may be brought into a solid state by cold and volatilized by heat, and that it offers a good solvent for many substances. Paracelsus, a prominent physician and chemist of the sixteenth century, found that, on treating iron with sulphuric acid, a gas is given off. Boyle, in 1672, discovered this gas to be inflammable; thirty years later, its detonating properties in contact with air became known; but not until Cavendish, in 1766, devoted himself to the exact study of this gas was there any conjecture established on the relations existing between it and water. In 1787 Cavendish made the discovery that, by combustion of this gas in air, water is generated; but, prejudiced by the chemical theories then prevailing, he failed to explain the process in the right way. We are indebted to Lavoisier for a correct definition of the changes taking place in the combustion of hydrogen, which name he gave to the gas in question, signifying a body from which water may be generated by uniting it with oxygen. Thus Lavoisier, supported by the discovery of oxygen by Priestley and Scheele in 1774, became the originator of chemical synthesis. It is a trifling experiment nowadays to demonstrate the formation of water by placing an inverted glass over a jet of burning dry hydrogen, when a dew of water will cover the sides of the vessel and gradually gather into drops.

A rapid advance in synthetical knowledge took place during the third and fourth decades of this century, the artificial preparation of a long series of organic compounds becoming known; and it is a surprising fact, although the chemistry of the carbon compounds, or organic chemistry, was in an infantile state at that time, while most mineral bodies were pretty well known as to their composition and character, that the manufacturing of the former with all their physical and chemical properties was successfully performed, while the imitation of minerals in their

peculiar structure and appearance frequently met with unsurpassable difficulties. Even our most modern expedients do not enable us to imitate more than a few well characterized and crystallized minerals regarding shape, luster, and other physical properties. We can build up the carbonates of calcium, iron, and manganese from their elements, but we lack the means to give them the rhombohedral form in which they are naturally found. It was only in the course of the last year that Krontschuff made known the first method of crystallizing silica in the hexagonal form of quartz; and that Fremy and Meunier succeeded in gaining real rubies and spinels by a melting process. It also required long years of incessant experimenting to find out a way of manufacturing the splendid blue coloring matter, ultramarine, as an approximative imitation of lapis lazuli. We should be at a loss, if requested to prepare crystallized manganic binoxide, or calcium triphosphate, or most other crystallized compounds spread throughout the rocky schists of the earth.

Asking for the reason of this insufficiency of our chemical faculties, we find it to be the impossibility of providing, through a sufficient length of time, those conditions of heat, pressure, and other circumstances which prevailed and were of influence when such compounds were separating from molten masses of mineral matter, or from saturated solutions, the composition of which will always remain concealed from us. Organic substances, on the contrary, of the most various kinds, are continually formed and decomposed in the bodies of plants and animals, very readily combining and separating under conditions which exist everywhere, or which may easily be induced. The extraordinary mutability of the compounds of carbon with hydrogen and oxygen is a feature particular to this element, not equaled by those of any other. Their liability to chemical changes enables us voluntarily to build up and to reconstruct carbon compounds occurring in organisms as well as those derived from them.

Alcohol, one of the best-known products of chemical industry, may serve as evidence to what degree of perfection the composition and decomposition of chemical compounds has been brought. As the chief constituent of intoxicating beverages, alcohol, together with carbonic acid, originates by fermentation from sugar; but this is not the only possible way to produce it. The brightness of electric lights, by which public places, roads, stores, etc., of our cities now are illuminated at night, is emitted by an electric current passing between two carbon points. When such a passage of electricity takes place in a glass balloon filled with hydrogen, the electric current causes this gas to unite with carbon, forming acetylene, a gaseous compound, which in contact with more hydrogen readily takes it up, forming a second gaseous compound—

ethylene—which is the chief light-giving constituent of illuminating gas. Ethylene, when brought into contact with sulphuric acid, forms a liquid combination, and this when treated with potassium hydrate is converted into alcohol. Having thus built up from its elements a substance formerly known only as a product of fermentation, we may proceed at once to decompose it again into its elements. We can easily regain the carbon which it contains, by heating alcohol with sulphuric acid, which again converts it into ethylene; and this gas, when mixed with chlorine gas and lighted, burns away, leaving carbon, which as a dense black smoke fills the vessel.

An event very encouraging and helpful to synthetical investigations was the artificial preparation of urea, a product of secretion in animal bodies, resulting from the decay of muscle, and one of the most important substances in animal exchange of matter. When Woehler, in 1828, found out that, by a chemical process, it can be composed with all its physical and chemical properties, this event gave a tremendous shock to the foundations of the doctrine formerly believed, that a "vital power" governed the functions of the organs of living animals, independently of physical as well as of chemical forces. The discovery of artificial urea was followed by others in an uninterrupted series, which, besides the practical interest they were entitled to claim, threw a new and clear light upon many processes in organic life. In glancing at some of them, we confine ourselves to cases of more general interest.

A conspicuous instance of the degree to which synthetical chemistry has enabled us to imitate nature in some of the processes going on in the bodies of plants and animals is represented by the changes which salicin undergoes. It is to this white and crystalline compound—belonging to the chemical group of glucosides—that the leaves of willow and poplar trees owe their bitter taste. Several species of *Spiræa*, while young, also contain salicin, which, during growth, is converted into a volatile oil of reddish color—salicylic aldehyde—an oil which, remarkably enough, is also produced from salicin in the body of the larvæ of *Chrysomela populi*, a beetle feeding on the leaves of poplar-trees. In *Spiræa*, as well as in other plants containing this oil, it is partly transformed into salicylic acid, which in its turn in *Gaultheria procumbens* and *Betula lenta* combines with methyl to form a product known as "wintergreen-oil." Now by synthesis we can artificially reproduce all these changes, though pursuing quite a different way from that which Nature follows. We can convert salicin into salicylic aldehyde; we can transform this into salicylic acid, and we can produce wintergreen-oil by combining this acid with methyl. We can even manage to prepare salicylic acid and wintergreen-oil from coal-tar, a substance which, as everybody may

judge by the way of its production, is not likely to contain any ingredients found in living plants. The preparation of salicylic acid from the products of coal-tar was discovered by Kolbe about twenty years ago, inducing a more thorough study of the properties of this acid, from which it was found to be one of the most valuable remedies for rheumatic complaints and for gout. Thus one discovery often becomes the source of a whole series of new ones, and may prove a blessing to mankind in the most unexpected and various ways.

Few people know what xanthin is. The name, indeed, represents a body of neither commercial nor industrial significance. Scarcely anybody else but chemists and physicians knows that it is a substance which, in a small amount, is found in muscles, in the liver, brain, and certain other organs of the animal body. But little, therefore, does he who enjoys a cup of cocoa, coffee, or tea, fancy that the beneficent, animating effect of these beverages is due to the methyl compounds of xanthin, contained as theobromine in cocoa-beans and as caffeine, in coffee-beans and in the leaves of tea and several other plants. Both theobromine and caffeine can readily be prepared from xanthin, the products having exactly the same physiological effect as the natural compounds.

The line of products of organic life which have been built up artificially from their constituents includes representatives of many groups of compounds, although they are not equally numerous in all of them. A large number of vegetable acids may be synthetically prepared. The volatile oils of bitter almonds and mustard, as well as the coloring matters indigo and alizarin, besides being prepared from plants, are obtained from other sources by chemical processes; but, since their original production depends on fermentative actions, to which the material is subjected, they can not justly be classed among natural products. In some groups of natural organic compounds our efforts to obtain them by synthesis have hitherto almost utterly failed. Our knowledge of alkaloids, many of which, by their great physiological effects, are of prominent therapeutic importance, has advanced so far as to permit us to convert some of them into others—for instance, to transform morphine into codeine; but, with the exception of conine, which Ladenburg claims to have synthetically obtained, and conhydrine, prepared by Hoffmann, both of which are contained in hemlock (*Conium maculatum*), no success of consequence has been registered. Nevertheless, as the knowledge of their chemical structure has been cleared up to a very considerable degree, we may expect that, by continued researches, ways for their artificial manufacture will be found out.

Many chemical discoveries were made by accident; compounds of valuable properties were found by researches under-

taken for other purposes; the knowledge of the making of china and of the separation of phosphorus resulted from experiments intended for producing gold. But the principal successes of modern science in general, and of chemistry in particular, were obtained in a speculative, inductive way, the only one to be considered as actually scientific. With positive surety the astronomer, from the movements of the stars, and from the attracting forces which they thereby manifest, can ascertain the presence of another star which has never been observed before. He may prophesy a solar eclipse to the accuracy of a minute, and many years before predict the return of a comet. In a similar way exact chemical knowledge often enables us to foretell the formation of certain compounds hitherto unknown, and to define the properties they may be expected to have. It was in this way that, the composition and chemical structure or arrangement of atoms in the molecule of conine and conhydrine having been explored, their preparation was likewise effected, the operators being guided by logical inferences. This scientific way of proceeding proved successful in numerous cases, and led to some surprising results in the course of the last year.

Not many years ago what was known regarding the source from which common plants draw their food consisted in the recognized fact that carbonic acid and water, both abundant in air and fertile soil, are taken up by the roots, converted into sugar by an unknown process, the sugar afterward being transformed into cellulose, the matter chiefly constituting the body of the plant, and into starch. It was also known that oxygen was set free in the course of these changes. In 1870 Baeyer promulgated a theory, explaining how assimilation of the mentioned substances might be effected. He demonstrated the possibility of "formaldehyde" being produced from carbonic acid and water, which is only possible, if—as is the case—oxygen is liberated. All plants in daylight exhale oxygen and absorb carbonic acid. Formaldehyde, a gaseous compound, is, as aldehydes in general are, very liable to condense to solid compounds by accumulating a greater number of atoms into one molecule. Baeyer expressed his belief that sugar, the composition of which agrees with that of formaldehyde multiplied by six, is the product of such a condensation.*

The first signs that sugar might result from such a condensation, when conducted in the proper way, were observed by Butlerow, but since he claimed to have prepared a sugar-like compound from formaldehyde, all the experiments undertaken to the

* The chemical changes in question are represented by the equations:

Carbonic acid and water = formaldehyde and oxygen

$$CO_2 + H_2O = CH_2O + O_2$$

Six formaldehydes, $6CH_2O = C_6H_{12}O_6$, grape-sugar.

like purpose had proved futile. It was Loew who in 1886 succeeded in preparing a more concentrated solution of formaldehyde than could be made before. He found that the vapor of wood-spirit in contact with heated oxide of copper furnishes formaldehyde in abundant quantities. Moreover, he found that condensation of this aldehyde to sugar is easily achieved by digesting a solution of it with slaked lime. The product, to which he gave the name of formose, has exactly the composition of grape-sugar; it has a sweet taste, and acts on Fehling's solution as sugar does; the resemblance extends to several further properties; but still there are some slight points of difference, which have caused a few chemists to raise objections as to its classification among sugars. The question of the formation of sugar from aldehydes would perhaps have remained undecided for the present, had not recent experiments, made by Fischer and Tafel, confirmed the statements before mentioned by giving evidence of the formation of sugar by condensation from other aldehydes. Their statements were supported by Grimaux, who, by subjecting glycerin to the oxidizing influence of finely divided platinum, obtained a substance resembling grape-sugar in all its properties, which in contact with yeast even undergoes fermentation, producing alcohol and carbonic acid, and hereby manifesting the character of a true sugar.

These results not only enable us to prepare by a chemical process this substance, formerly only known to be produced by living plants, but they also afford important facts and proofs which justify us in expecting the synthetical formation of other compounds playing a part in the vegetation of plants, thereby acquiring an insight into those complicated phenomena of organic life which science hitherto has in vain tried to explain. By perfecting our comprehension of natural processes we become more and more enabled to utilize them for the advancement and the welfare of mankind—an attainment which constitutes the chief aim and purpose of natural science in general.

THE experiments of E. H. S. Bailey and E. L. Nichols, upon the delicacy of the sense of taste, indicate that the impression derived from bitter substances far exceeds that arising from any other class. The order as to the substances experimented upon is bitters, acids, saline substances, and sweets. The potency of quinine is very remarkable. Men who tasted could detect on the average one part of it in 390,000, and women one part in 456,000 parts of water; and to sugar it stood in potency as very nearly 2,000 : 1. The range of individual sensitiveness is very extensive. With all the substances tried, except salt, the taste of the women was more delicate than that of the men. But while some of the persons experimented with could detect with certainty one part of quinine in 5,120,000 of water, others failed to notice one part in 160,000. The sense of taste does not appear to be blunted for any substance by long-continued habitual use of it.

INDUSTRIAL FAMILY NAMES.

By Prof. D. R. McANALLY.

THE industrial history of the English-speaking peoples has been faithfully written by able hands, and, until more material accumulates by the growth of science and the progress of industry, little can be added to records already made. The study of what may, for the lack of a better name, be called industrial philology, has not, however, kept pace with the history of industrial occupations. Much has been well done in this line, for long ago students of language perceived that in the proper names of men and places lingered unwritten histories, but all yet accomplished scarcely makes an impression on the huge heap of material, since most proper names once had a significance which, in many cases, has long ago been forgotten.

Even a casual examination of the family names of men discloses the fact that many of the most common must have originated in the adoption, by an individual, of the name of his occupation as a surname, to distinguish him from other men of the same given name. Dr. Adam Clarke, in his "Autobiography," has a learned and critical essay on his own name, and accounts for its use by his family in the manner already indicated. There can be no doubt that this is a typical illustration, nor that, during the period when the English language was assuming its present form, many trade-names became those of individuals, and frequently, when men more than commonly distinguished themselves in a calling, were assumed as distinctive surnames by their children, and were thus continued when the propriety of the appellation no longer existed. In this way multitudes of trade-names are perpetuated, some in their original form, some so modified as to be scarcely recognizable, and others, no doubt, which once were designations of trade, so changed as to bear not a trace of their origin. Concerning the last named speculation is profitless, and even those of the second class may be passed with little notice, since quite enough material is found in family names which plainly proclaim their own ancestry.

The food-providing occupations have always, of necessity, been thronged, and from them come, in more or less altered form, many of our family names. The Butchers and Slaughters tell their own story, so also do Flesh and Flesher, since in Scotland and the north of England the purveyor of fresh meat is even to-day known as the "flesher." But Fletcher and Flitcher need to be introduced as the lineal descendants of Flesher, while Boucher and Bouchelle would be unidentified were not the fact known that

our ancestors had much intercourse with the Normans, and, in the eleventh and twelfth centuries, French was daily spoken by the better class in the British Isles. Our Bakers may be readily traced back to their floury-handed ancestors, but the Baxters must be followed for generations before we find that they were of the same family, being the descendants of the Bagsters, who were the offspring of the Bagesters, who acknowledged that they were the children of the Bakesters, who were feminine bakers. Of the bread-making tribe were also the Breaders and the Whitbreads, the latter perhaps once priding themselves on the color of their stock in trade, while nearly related to them were the Mills, the Millers, and the Mealers. The large and respectable family of the Boulangers came from the French bakers who carried on their trade in England during the ages when family names were growing, while Mr. Lowe suggests that the Bollingers and the Bulliners are of the same origin.

Few points in Great Britain are more than a hundred miles from the sea, and in all ages fish has formed one of the staple articles of British diet. Catching the fish was therefore an important industry, and Fish, Fisher, and Fisherman doubtless had their origin in the occupation of the men who first assumed these names, of which fact there is abundant record. It is quite possible also, as Max Müller suggests, that men may have made a specialty of taking or of selling a particular kind of fish, and thus Salmon from Robert le Salmoner, Hering from John le Heringer, and Trouter from Roger le Trowter, may have arisen without violence to the laws of philology. Bardsley, in his book on English names, derives Possoner from le Poissonier, another relic of the French occupation of England. The selling of fruit was, in the three centuries after the Norman conquest, a special occupation, and mention of John le Fruiterer occurs in the Golden Roll, the conclusion being drawn by philologists that Fruter, Frooter, and several similar names thus had their origin. Cheese was furnished by Roger le Cheseman in the twelfth century, whence our Cheesemans and Chesmans, while condiments of various kinds came from a special store where nothing else was kept and the owner known as le Spicier, no doubt the ancestor of some of our Spicers. Fowls were sold by the poulterer, from which word, it is believed, Polter is derived; while Grocer, as a family name, needs no explanation beyond the statement that in mediæval England his assortment of goods, while not so extensive, was quite as varied as at present.

The preparation of food for immediate consumption gave rise to another occupation and other names. The Cooks we still have with us, also the Cokes, the latter being the more common spelling of the word in the thirteenth century. From these, by natural

succession, come the Cooksons, the Cokesons, the Coksons, and, one scholar suggests, the Cocks and the Cocksons—the last two, however, appearing to be far-fetched. As drink was to our forefathers quite as indispensable as meat, it also gave rise to family names, being manufactured by Brewers, Maltsters, and Vintners or Wintners, remaining as Winters, and dispensed by Tapsters and Drawers. Nor should it be forgotten that receptacles for the liquors were from the hands of the Barilers, Hoopers, Coopers, and Cowpers; nor that the contents of the casks were carefully ascertained by the Gaugers and Measurers. Bowlers and Bowlings, with Cuppers, made the drinking-vessels in use among the common people, Horns and Horners those of a better class—all of whom, with verbal changes, remain to attest the former popularity of their respective callings.

Workers in wood have left their record among our proper names to such an extent as to justify the conclusion, even if it were not to be reached from other sources of information, that this branch of industry was important during the ages when men were assuming family names. Caring for the raw material in its growing state gave us the Forrests and the Forresters, the Woods, Wooders, Woodsons, and Woodmans. Cutting the timber into proper lengths was the business of the Sawyers, perhaps also of the Hewers, while dressing the lumber originated the Carpenters. The Carvers did the ornamental work, so, according to Lowe, did the Cutters and Cuttings, though about these names there is a difference of opinion, some assigning them to the leather trade and others to the stone-cutting.

Akin to the lumber business is the Houser, who, according to one authority, is of the same family as the Bilders and Bildermans, which names, it is supposed, originated with master-workmen who undertook the general contract of setting up a house. Nearly related also are the Thatchers, the Thackers, the Thackerers, and the Thackerays, who, always in the country, and frequently in town, covered the house after it was erected. But houses in Great Britain were more generally constructed of stone or brick than of wood, and artisans in these materials must have been numerous, as is evidenced by Stone, Stoner, Stonebreaker, and Stoneman, the Masons, the Carvers, and, as already mentioned, the Cutters also. The Tylers made and placed in position the tiles used for roofing, while the Painters, Paynters, and Penters made both exterior and interior of the building presentable.

The Tylers just mentioned were workers in clay, which suggests another branch of industry, from which numerous family names have sprung. Not to speak of Clay, Claye, Clayer, and Clayman—the preparers of or dealers in the material—there are Pott, Potts, Potter, Pottman, Crock, Crocker, Crockman, Jarman,

Plater, Disher, and, according to Taylor, Turner also, though some assign this name to the worker in wood. The burden of proof, however, seems to make the original turner an artist in jugs, the propriety of the name in this case being manifest.

From wood, stone, and clay the transition to the metals is easy and natural, and of the skill of our Saxon forefathers in this direction there are abundant records in the family names still remaining in common use. Iron, Ironer, and Ironman are common; Copper, Coper, Copperer, and Coperman equally so; while Leader, Lederman, and Lederer come down almost unchanged from Roger le Lederman, mentioned in a parliamentary writ of the thirteenth century. Brasser and Brassy still exist, along with Tiner and Tyner, to testify to the variety of metals used, while Silver is as rare as Golden, though both exist in our directories, and doubtless tell of the occupations of their originals.

When metal-working is considered, the family names indicative of occupation are equally significant. Smith needs only a mention as a sort of generic term; Coppersmith is often seen, together with Goldsmith. The manufacture of special articles of metal gave rise to several family names—such as Spooner, Knifer, and Nypher—Ralph le Spooner and John le Knyfere appearing in the records of that period. The cutler then as now dealt in small articles of hardware, and the Cutlers remain to bear witness to the popularity of the business; while Armour speaks of the development of the craft in another direction.

Leaving metal-working for the manufacture of textile fabrics, Prof. Müller has some very interesting notes on the manufacture of flax as connected with the growth of the English language. From these it is evident that several family names originated with the linen trade. There are Flax and Flaxman, Linn, Lynn, and Lynnman, who doubtless provided the material, lin being a Saxon name for Flax; and, with some probability, it has been suggested that White, Whitener, Whitner, Bleach, Blake, Blaker, and Blakeman had their origin in the process of bleaching the goods. Leather, too, furnished names as well as occupation to those who dealt in it or busied themselves in various branches of its manufacture. The records of the twelfth century have preserved for us the names of Ralph le Hyder, Roger le Skinnere, John le Curier, Thomas le Tannere, whose philological descendants still appear on the pages of our directories in varied spellings, while the Shoemakers are almost as numerous as the Glovers. Sowter, Sutter, and Soter are modifications of Souter, once a common name for a shoemaker, while Clouter, Cloter, and Cloutman, together with Cobbler, Cobler, and Cobbleman, are forms of a different word of the same signification, and the Pattens, Pattons, Pattenmans, Pattermans, and perhaps Pattersons, took their names from

the patten, a sort of clog much worn during the twelfth, thirteenth, and fourteenth centuries. Taylor finds Bark and Barker in the old writs of that period, and suggests that the occupation of the first owners of these names was to provide the tanners with the material for converting the hides into leather. This may or may not be the case, but it is reasonably certain, according to the best authorities, that our Butlers were once the Botelers, bottles in that day being frequently made of leather, and the name being applied first to him who made the bottles and, after a time, to him who looked after them and their contents.

Rope-making is not distantly related to the leather trade; and of the manufacture of ropes relics are still seen in Roper, Corder, Stringer, and Twyner.

One of the most curious pages of philological history is that written by Bardsley in recounting the proper names which grew out of the wool trade. For ages wool was the staple of England, and thousands of busy operatives were employed in the various processes necessary before the wool could be transferred from the back of the sheep to the back of the man; before the raw product could be converted into the finished manufacture. At every step, proper names indicative of the calling of those who bore them sprang up, so that, were we ignorant of the fact that the Saxons dealt in wool and made cloth, we might draw perfectly correct and legitimate conclusions as to the business, its extent and various departments, from the family names still surviving. To follow Bardsley in this quaint pilgrimage through the woolen-factories of Old England: the sheep were cared for by the Shepherd or Sheepherd, a name which with variations of spelling is extremely common. Shearing was the first operation requiring either delicacy or skill, and Shearer, Shearman, Shurman, and similar names bespeak their own ancestry. The wool was then placed in bags, made by the Sackers or Canvassers, and was ready for the merchant, an individual often known as Stapler, Wool, Wooler, Woolman, or Woolsey, or in French as Lanier or Lanyer. He consigned it to the care of persons who transported it from place to place on the backs of pack-horses or in vehicles, and were thus known as the Packers, the Carters, or the Carriers. The wool was then handed over to the Carders and Combers, or Kempers and Kempsters, as they were variously called, and passed from their hands to those of the Spinners, who used implements made by the Spindlers and Slayers, afterward going on to the Weavers, Weevers, Webbs, Webbers, or feminine Websters. The cloth was next "teased" to bring out the nap, a process done by the Teasers, Tosers, Tousers, Teazelers, or Taylors, when it was finished and ready for the Dyer, Litter, or Lister, or the Norman Taintor or Taintur. Woad, the common dye-stuff, was provided

by the Woader or Woadman, while there is some indication of another material in the names Madder, Madderer, and Madderman occurring in the Hundred Rolls. The Fullers, Fullertons, Fullersons, and Fullmans undertook the process of whitening the cloth, if it was to be white, in which they were assisted by the Walkers, who trod it with their feet, accompanied by the Beaters, Beatermans, Bates, Batts, and Battmans, who used sticks instead of heels and toes.

The designation of the process is seen to give a name to all engaged in a special work, just as at present, and further to be adopted as a family name by some who perhaps attained notable excellence over their fellows, or were led by chance or caprice to adopt the title of their calling as their own surname. The list might be indefinitely extended. Tuck and Tucker, Sticher, Seamer, Sower, Braider, Wash and Washer, Lavender and Launder, terms formerly designating the cleansing of linen, are illustrations to the point, and many others can easily be gathered by any one having the time and patience for such research.

Particular articles of apparel, either in the course of manufacture, or completed and in use, have left their imprint in several family names. The hat gave us the Hatts and Hattars; also, according to Taylor, the Blocks, Blockets, Blockers, and Blockmans, the last four taking their names from the wooden instrument on which the hats were shaped. Caps gave us the Cappers and the Capers; smocks, a loose, shirt-like outer garment worn by peasants and workingmen, the Smockers and Smookers; the pilch, a fur cloak, the Pilchers, Pulchers, and Pitchers. The manufacture of belts gave a name to the Girdles, Girdlers, and Girdleys, while the wearing of laces originated Lacer, Lacy, Pointer, and Poynter. The use of furs originated the Pelters and the Furriers. The cowl, as an appendage to a great-coat, was much in use when family names were growing, hence Cowler, Cowley, Cowlet, and the like; while another name for the same article originated the Hoods and the Hoodmans. Fastening the clothing with buttons originated the Buttons and Buttoners; with buckles, the Buckles and Bucklars; while the use of pins, at first of great size, gave names to Pinners, Pinnets, and Pinneys; and the manufacture of a small bag for the safe keeping of money was the original employment of our Pursers, Bursars, and Pouchers. A call for precious stones was answered by the Jewells, Agates, Rubys, and perhaps Crystalls, and the necessity for light in the houses and streets was met by the Candlers, Lampers, Lighters, Links, Linkers, and Torchers.

Mention of the last classes suggests the nature of the service they rendered to our belated ancestors in the unlighted, muddy, and otherwise dangerous streets of mediæval London, and this

calls to mind the fact that in personal service have originated a number of family names. The old Saxon had his face scraped by a barber, whence our swarm of Barbers, Barbars, Barbors, Barbours, and Burbers; while in those days the hair of the ladies was artistically "tired," whence the Tyers, Tyrers, and Tyermans of the present day. When sick, or "ill," as his descendants now say, he sent for the leech, and this worthy has left a numerous progeny among the Leeches, Leaches, and Leachers. His letters were written by scriveners, who still remain among us as Scribners; and, when he needed relaxation, he was entertained by Players, Dancers, Whistlers, and Singers.

THE HOME OF THE FERNS.

By T. JOHNSTON EVANS.

IN the New World, as well as in the Old, there is many a charming spot, far away in the wild woodland or within the sunless recesses of deep-furrowed mountain gorges, which might well merit the designation by which this paper is prefixed. Indeed, for a very long period the ferns of North and South America have received considerable attention at the hands of botanists; nor must it be forgotten that, centuries before the white man set his foot upon the great continent of the West, several species of these beautiful plants were much sought after by the aborigines. The common polypody (*Polypodium vulgare*), which is one of the most frequently met with ferns in the Eastern States, was highly valued by the various Indian tribes for its medicinal properties, while Kalm also relates that the red man seems to have universally used the beautiful maiden-hair (*Adiantum capillus Veneris*) as an infallible cure for cough and difficulty of breathing. Fascinating, however, in the eyes of botanists, as are the various homes of these beautiful plants in the Northern and Southern States, there is beyond the Atlantic one spot above all others upon which Nature has lavished her most glorious gifts, which, *par excellence*, may well be termed "the home of the ferns."

Justly celebrated for the wondrous beauty of its diversified scenery of waterfalls and lakes and towering mountains, crimson in their autumnal glory with the ripe berries of the arbutus, this favored locality is also especially remarkable for the luxuriant growth of the rarest and most highly prized by collectors of European ferns.

Accompanied by a few scientific friends, among whom were a practical geologist and a skillful field botanist, I recently paid a visit to this fascinating region. It was toward the close of Septem-

ber, the best period of the year to see Killarney in all its many-hued glory. The morning after our arrival at the Lake Hotel looked, indeed, most unpropitious for our proposed pedestrian excursion around the upper and lower lakes. A dense mist enveloped everything in its vapory folds, preventing objects, even within a few feet of us, from being distinctly visible. Our aneroids were, however, rising rapidly, and we were assured by the weather-wise folk that before midday the fog would be "lifted" by a light breeze, which would be sure to spring up. After having breakfasted, we set out on our not particularly inviting tramp, selecting the route in the direction of the lower lake. Along that exquisitely beautiful and well-known path which, canopied by trees of various foliage, winds close by the marge of this charming sheet of water, we took our course, preceded by the inevitably loquacious guide. As we pursued our beclouded way, the rush of the foaming cataracts dashing madly from the hills, which rose to the height of some three thousand feet above us, came upon our ears from time to time, and splashed us with their spray, but yet were completely invisible. Even the water which rippled on the pebbly beach at our feet was as much hidden from our view by that all-enveloping mist as though Egyptian darkness surrounded us. As may be imagined, our walk was not a very enjoyable one, but we were soon destined to be amply recompensed for our pains. Two hours had elapsed from the time of our setting out, and noon found us sitting on the parapet of that romantic bridge which spans the outlet between the upper and lower lake. While we were deliberating whether to return or continue our walk, it suddenly became evident that the surface of both lakes was agitated by a strong gust of wind, which, as we afterward learned, came down through the celebrated Gap of Dunloe. The previously motionless mist began immediately to wreath itself in upright columns, to which the breeze gave a kind of rotatory motion as they were suddenly lifted up from the surface of the water. Then followed, with startling rapidity, one of the most wondrous natural transformation scenes it is possible to conceive. In less than six minutes, not merely were the two lakes spread out before us, from shore to shore, in all their beauty, but the thick masses of vapor had rolled up the sides of those gigantic hills which overhung them, and the brilliant sun was shining merrily out of the bluest of skies. I had previously witnessed similar cloud-phenomenon amid the peaks of the higher Himalayas, but nothing which for startling effect and scenic beauty could bear comparison with this

It was the first acquaintance which every one present, myself excepted, had made with Killarney, and it was scarcely to be wondered at that from every lip burst an ejaculation of glad sur-

prise. In the splendid surroundings which, as if by the wave of a magician's wand, had been so suddenly unfolded to our view, the mere worshiper of the beautiful in nature had sufficient to demand his warmest devotion; but to the scientist the spot was more especially holy ground. My friend the geologist beheld in those great Kerry hills—the Magillicuddy Reeks, the Toomies Mountain, and magnificent Mangerton—one of the oldest formations in Europe; while the botanist speculated upon the treasures which lay scattered above and around him in the shape of ferns and club-mosses and purple broom.

The following day we specially dedicated to the collecting of those rare and delicate ferns which abound in mossy nooks and in spots kept constantly moist by the spray of some foaming cascade as it leaped from ledge to ledge in its impetuous course. One of the ferns, specimens of which we were most desirous to obtain, was the *Trichomanes*, or bristle fern. This exceedingly beautiful plant, though plentiful in Madeira, is absolutely unknown in any European country except Ireland, and even there is only now to be found in certain districts of the extreme west. It may be described as having fronds three or four times pinnatifid, segments alternate, linear, entire or two-cleft, obtuse; involucres solitary in the axils of the upper segments. The bristle fern delights in shade and moisture, and our first find was in a rocky cleft in the immediate neighborhood of the Tork waterfall. Subsequently, within the dim recesses of a cave, the mouth of which opened upon the upper lake and could only be approached by a boat, we discovered several splendid specimens, one of which, with a creeping rhizome, some three feet long, contained no fewer than thirty perfect fronds. Nothing that I have ever seen in my varied experience of fern-life equaled the delicacy and pellucidness of these fronds, nurtured in the darkness and the mist. The veins were so prominent, and the green portion so like a membranous wing around the veins, that it resembled more a beautiful sea-weed than a fern. In this natural cave we also discovered some of our finest specimens of the *Adiantum*, or maiden-hair fern. This plant is called the true maiden-hair, to distinguish it from some other ferns which share its familiar name. The bright evergreen tint, the elegant form, and lightly waving attitudes of this fern render it very attractive, and when growing against the sides of the sea-washed rock, or any moist place in any abundance, no fern exceeds it in beauty. It has not been found in Scotland, and in but few districts in the south of England; in the ravines and mountain gorges throughout the west of Ireland, however, the collector is seldom permitted to go unrewarded for his diligent search. Two other rare species we also discovered in this "home of the ferns"—that exquisite variety of the polypody denominated *Hibernicum*, and the beautiful beech

fern, *P. phegopteris.* The latter plant is also called the sun fern; it has a decided preference for mountainous districts, where it often grows at a great elevation, though it may frequently be found clinging to rocks in the recesses of dark woods, or, as in the present instance, festooning the mouths of natural caverns. Several little variations occur in the form of the common European polypody, the lobes being more or less cleft, or acute, or serrated. One of the most important is that termed *Cambricum*, the Welsh polypody, in which the lobes become broader and are again irregularly lobed and toothed. This is always barren. The variety *Hibernicum*, or Irish polypody, has a broader, twice or thrice pinnated frond, and is fertile. It is an exceedingly handsome form of the fern. The French call this fern *le polypode;* the Germans, *der Tipfelfarren.* It is the *boomvaren* of the Dutch, the *polepodio* of the Spaniard and Italian, and is known in Russia by the name of *osokor.*

Having thoroughly explored the treasures of the cave, and possessed ourselves of specimens of some twenty different species of ferns which had made their home within its damp and sunless interior, we once more set out for pastures new. Almost immediately beneath the Gap of Dunloe a beautiful object met our sight. In the midst of a group of immense gray bowlders, which lay in wild confusion at the opening of a romantic gorge, grew in luxurious abundance quite a large bed of the superb holly fern (*Polystichum lonchitis*). How fresh and beautiful those evergreen fronds looked in one of the wildest spots to be found in all Killarney may well be imagined: higher up the "Gap" we subsequently discovered other and smaller beds, but, remembering how difficult of cultivation the holly fern is, we refrained from taking more than two or three specimens. The higher we ascended the mountain the more stunted became this remarkable species, until at length it grew only to the height of some six inches, still retaining its marked characteristics. The stalk of the frond of this fern is exceedingly short, and the dark, glossy green leafy part is firm and rigid, and sufficiently prickly to remind us of the holly. The young fronds appear early in spring, among the yet verdant fronds of the previous year. They are pinnate, with short, crowded, overlapping, twisted pinnæ, which are somewhat crescent-shaped; the upper side having at the base an ear-shaped projection, while the lower side has the appearance of having had a piece cut out. The veins are twice or thrice branched, reaching nearly to the margin without uniting with others. The indusium is a membrane-like scale, and the clusters of fructification form a continuous line on each side of the midrib, and even with it. They are frequently very numerous on the upper pinnæ.

Our small party unanimously agreed that the fern which

formed the most prominent feature throughout the Killarney district was the *Osmunda regalis*, or flowering fern. This stately species is not unfrequently called the king fern, and certainly it well deserves its regal name, which, however, appears to have been bestowed upon it through other circumstances than its crested form. Its name, *Osmunda*, is of Saxon origin, and perhaps was given in honor of some chief who in olden time bore the name of Osmund, that being one of the titles of Thor, the Celtic Thunderer. This attractive plant is so different in its appearance from other species that the botanist only would recognize it to be a fern, unless the veining of its leafy frond were examined. It generally rises to the height of five or six feet, and in congenial situations not unfrequently attains the height of ten feet. The young fronds of the *Osmunda* are usually about ten or twelve in number. Their large leaf-sprays are thin and crisp, and of a bright sea-green color, usually assuming a deeper green as the plant grows older. The stalk, which is at first reddish brown, afterward becomes green, and contrasts well with the rich rust-brown spikes of fructification. Nothing could be more beautiful, more in accordance with the surroundings, than the manner in which a considerable portion of the two lakes were literally fringed by the *Osmunda*, the long fronds of which arched gracefully over and dipped their masses of seed in the crystal water, while beneath the canopy thus afforded them the saucy coots flitted to and fro and gazed fearlessly upon the passing stranger.

Though some of the ferns I have mentioned may have superior claims in the eyes of botanists and collectors of rare species, it must be acknowledged that there is not one more universally popular than the graceful *Athyrium filix fœmina*, or lady fern. Indeed, not a few botanists have pronounced it to be the loveliest of all British ferns, possessing as well the great charm of commonness. Walter Scott, alluding to this plant in "Waverley," mentions its love for the moist, shady woodlands:

> "Where the copsewood is the greenest,
> Where the fountain glistens sheenest,
> Where the morning dew lies longest,
> There the lady fern grows strongest."

Undoubtedly, among the copsewood which covers a considerable portion of those grand hills which cast their shadows over the upper and lower lakes of Killarney, the lady fern attains a perfection not observable elsewhere, though the writer has gathered a somewhat scarce variety (*A. latifolium*) near Keswick, in Cumberland, and also a very peculiar species called *crispum* at Braemar, in Scotland. The plant is doubtless too well known to need description here, though it may be observed that its fecun-

dity is such that a celebrated botanist has said of it that "if a single plant were uninterrupted in its possible increase for twenty years, within that time it would cover an extent equal to the entire surface of the globe."

Our botanizing excursion, so successful, so full of interest, and so much enjoyed, having concluded, we bade adieu to matchless Killarney, and will not soon have effaced from our memories "the home of the ferns."

ORIGIN OF SOME GENERAL ERRORS.*

By Hans S. EXNER.

WHILE we endeavor to distinguish between instinct and reason, we are accustomed to speak of such skill and conformity of actions to a given end as are exhibited by birds in building their nests, or by societies of insects, as more resembling what we call reason. We may mark the difference, however, by observing that instinct develops its qualities only within a limited sphere and in view of a limited end. Birds can weave filaments into nests, attach them to branches, and adapt the forms of their work to those of the tree and its limbs; but their talents in weaving are of no use in helping them release themselves when caught in a snare, and they will then struggle as wildly and vainly as an animal that never built a nest. A hen will lay an egg every day in the same place till the quota is completed, and will then sit upon them; but many hens will sit all the same, and for the full time, if the eggs are taken away as they are laid. These examples illustrate how instinctive processes are produced simply as determined combinations—or work only in view of a special end. The actions provoked by them will remain the same, even when they have become purposeless. On the other hand, the associations of the processes can not be broken, and the skill which the bird directs to building her nest is not capable of being employed for any other end.

The more developed the instinct, the more stable are the combinations of phenomena and nervous conditions under which it works; the weaker the combinations, the more nearly the animal's mode of action approaches what we call reason. We should judge of the intelligence of an animal, not by single acts surprising to human understanding, but according to the diversity of the situations in which that animal can use its faculties. The weakness of reason in the animal always has the same character, and lies in the impossibility or difficulty of breaking certain associations and the incapacity to produce out of two combinations, by transferring a

* From a communication to the Sixty-first Congress of German Naturalists and Physicians.

number from one to the other, a third. Hunting-dogs show great skill in threading mountain-paths and overcoming or avoiding obstructions, but no dog will remove a branch interposed in his way. When the associations by which instinct works come into play outside of or against their ordinary end, we may speak of their working as imperfect, and may say that the animal is mistaken.

We also have instincts that are characterized by the narrowness of their end. Among them are the reflex actions. The eyes wink when they are threatened with injury; but they also wink when a beneficial operation is performed upon them, to which the winking is an obstacle, the action going on all the same when it is useless or injurious.

I believe it can be shown that this type of instinctive action is also found in man, and that the origin of many types of errors may be found in the application to particular cases, but exceptional, of what is generally right. This proposition is confirmed by some errors of the senses. When a point on our retina is excited by an external pressure, we fancy we see something luminous in the ordinary field of vision of that point. Were it not for the experience of previous observations of objects and their reflections, we should localize as things behind the glass the reflections which we see in mirrors. In this and most like cases, we are acquainted with the mechanism of the phenomenon, and can distinguish between what is only the sensorial impression and what we owe to memory. The separation vanishes in the higher regions of psychic life. If we draw a line on a sheet of paper and cover the end of it with another sheet, an observer not in the secret will imagine it to be much longer than it is, because his conception is based upon the fact that when one object lies upon another, it usually covers a considerable portion of it. We are subject to a considerable number of illusions of this kind. The prestidigitator takes advantage of one form of them when, by a quick look to one side, he turns the eyes of the audience away from his manipulation and gains an opportunity to execute the trick without detection, although every one of his spectators had determined not to lose sight of his hands. He is aware that a glance and particular adjustments of the head and eyebrows and lids will usually suggest to the looker-on that he will see at a particular point something more interesting than anywhere else within his field of vision. At the same time the audience will not know why they looked in that direction, and may not even be conscious of having looked there.

We thus deal on this domain, remote from the physiology of the senses, with functions of the nervous system similar to what we have seen in the hen and the winking. (Thought follows its course according to the usual process;) with more or less of con-

sciousness the ordinary train of associations is formed, and the judgment corresponds with what is correct in most cases. There is, therefore, no precise limit between instinctive actions and conscious thought; for every one can observe in his own mind that thought rests considerably on phenomena of association. An elevated intelligence is, however, distinguished from an inferior one by its richness in associations. The faculty of transposing the elements of one complexus of observations into another, the possibility of making a new combination, and the wealth of associations, are prime factors in determining the degree of intelligence. A large proportion of the mistakes to which we are liable originate in this kind of instinctive succession of associations usually correct and effective, in which associations important to the particular case are wanting. In other words, they arise from the association of the habitual with the omission of the special.

The thought can be illustrated by the citation of a few widespread logical errors. Where lotteries are drawn, the lists of the drawings are earnestly scrutinized by unsuccessful investors, who, if asked why they do so, will reply that, as all the numbers must eventually be drawn an equal number of times, those which have not been drawn for a long time stand the best chance of coming out soon. People often say, when it is raining hard, that it will be made up for by fine weather afterward. A kind of belief exists in a compensating providence that will bring grief after a long run of happiness; and it is illustrated in the legend of the ring of Polycrates. The mental processes leading up to error in these instances start from the premise that all the numbers have the same chance of winning; with which is associated the anthropomorphic idea of distributive justice, taking, in the legend of Polycrates, the form of divine jealousy; our recollections witnessing to a tendency to change; and past experience, teaching that, among a given number of objects, the probability of a particular one being found soon increases in proportion as the others are sorted out and put away; or, as in the filing past of a regiment, our expectation of finding our friend in the next rank grows as companies pass in which he does not appear. All this is true in general. The factor the omission of which in the particular case leads to error is that in the lottery all the numbers are put back into the urn before each drawing, and consequently what has been done has no influence on the probabilities of the present case.

So, when a certain person is spoken of as having "luck" at play; while he may have had unusual success—that is, a high number of favorable chances among all the possible ones—for a day or several days in succession, any association of his "luck" with his personal qualities is mistaken. We usually reason correctly that men succeed in their lives and enterprises whose per-

sonal qualities contribute to their success; but in this case there is no possible connection between the disposition of the cards and the qualities of the player. These associations are generally based upon supposed experiences, in which, besides the impossibility of securing exact observations, we commit the mistake of confounding coincidences with causal relations. We need not be surprised at them. They are incident to the relations of men with one another, and are confirmed by false observations and tradition, and they are what give its special character to each epoch.

These typical errors are not only met in the domain of common life; preserving their character, they possess the highest spheres of our activity, art and science; and in those domains we can see the fundamental difference between these two modes of the mind's action. While in science, the object of which is the truth, every error involves mischievous consequences, in art, which looks to the beautiful, illusion has full play, and in many instances even forms the basis of the best conceptions. Thus, in architecture, a balcony supported on slender bars of iron does not offer a pleasant appearance to us, while we are ready to admire the same structure if it rests upon shapely brackets of stone projecting to an equal distance from the wall. The apparent disproportion between the structure and the support in the former case is an artistic fault. It does not lie, however, in the calculations of the architect, which may be perfect, but in the "instinctive" judgment of the speaker. The prejudice is so general that architects often dress slender supports of iron with false brackets of plaster that will convey a more agreeable impression.

The psychological origin of this prejudice is found in our familiarity, from experience, and from having seen it used in buildings, with the solidity of stone, while we are not so well acquainted with the equivalent strength of less massive iron. In most cases the impression of solidity agrees with the sense of beauty, while the apparent disproportion of iron supports grates upon it. The balcony continues to look unwieldy even after we have become assured that the iron bars are amply strong. Our sense of beauty, therefore, rests upon an illusion in the presence of which it can not adapt itself to the particular case; but it is an illusion that every artist ought to regard. Such illusions are common in all art.

The proposition, "Style is the concordance of an artistic work with the history of its development, with all the circumstances of its production," which is elucidated in Gottfried Semper's work on "Style," defines the psychologic basis of every artistic production. For a work can have style only as it is in harmony with the mass of associations, mostly unconscious, which the spectator forms on the subject of its composition. This is why a majolica

cup should have a different shape from one of metal; why a cup of hammered metal should be distinct from a molded one; and why vessels of other materials should have their specific forms.

I have intimated that many of our most common associations arise from impressions that have acted upon us from our youth. The nature of these impressions is conditioned on the experiences of the generations that have preceded us. In other words, these traditions play an important part in our æsthetic impressions. The Greeks employed in their marble temples motives that dated from a distant epoch when building was done with wood. A diversion from these rules would have produced an unpleasant impression on the Greeks, and would have been contrary to the "style." Our case is not different. All of our ornamental motives are derived from time-honored traditions; and our æsthetic satisfaction in them continues unharmed by the reflection that in many cases they are no longer adapted to present conditions.

We meet errors of a similar class on scientific ground. Take, for example, the paradox of Zeno the Eleatic, concerning Achilles and the tortoise. The swift Achilles, it supposes, can never overtake the tortoise, because a distance intervenes between them, and he will have to run for a certain time before the distance is reduced by half, another length of time to reduce it to a quarter, to an eighth, and so on to infinity. More time is required to reduce the rest of the distance by half, and the number of these possible parcels is infinite; hence Achilles will never catch up with the tortoise. Now, since we know that he will overtake it, wherein is the sophism? It is not in any real contradiction between the laws of our thought and experience; but a typical error is involved, in which thought, moving in a way that generally leads to the truth, is at fault in the special case. It is true, in ordinary cases, that when we continue adding indefinitely new intervals to any interval of time, the sum of all will be infinite. This fact, generally valid, in the particular case leads our judgment to a false conclusion. The special feature in the problem is that if parcels of time, infinite in number, diminish according to certain laws, their sum will not be infinite, but may be very small. We do not have to be accomplished in mathematics to comprehend the sophism and find its solution. Every one knows that we can divide a length of one metre into a half metre plus a quarter, plus an eighth, etc., of a metre, and thus obtain an infinite number of factors, the sum of which, however, shall always be within a metre. The general error involved in the discussions of this sophism is also a typical one, for it originates in the predominance in our consciousness of the general law, with the non-association of the particular case. The phenomenon is therefore

analogous to those which we have observed in animals, to errors of the senses, and to other illusions of the reasoning faculty.

From the hen that sits on its empty nest to the problem of Zeno the Eleatic, there runs through animals and men a continuous series of errors, all of which have a common origin in the working of the nervous system conformably to the majority of cases without regarding any certain special and exceptional case, The typical character of these errors is related to the phylogenic development, and casts a degree of light on the unfolding of thought.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

THE PLEASURE OF MOTION.

By M. P. SOURIAOU.

MOTION gives both physical and moral pleasure. Physically, it enables us to remove ourselves for the moment from pain. Morally, it furnishes a satisfaction for our self-love, which is remarked especially in play and in our struggles against the forces of nature.

Before being a source of positive pleasure, our physical activity is stimulated by pain. Those movements, called spontaneous, which are the first signs of vitality in the child or animal, are explained by supposing them to be the reflex of some indefinite discomfort. Our organism is not a machine, as some say, in any of its parts, but is living and animated throughout. Even the organs that perform without the intervention of the will, and the play of which seems to be mechanical because it is not accompanied with a recognizable sensation, may have the rhythm of their movements determined by some local sensibility.

When I feel any suffering, I have only to execute some motion, to feel it less. Motion is the best of anæsthetics. It disperses at a stroke all the little uneasinesses that accompany even the normal working of our organs, and which we experience when we are occupied only with feeling ourselves live. When we make an energetic effort, we are nearly insensible to pain as long as it lasts. When I am at rest, a blow on the shoulder will hurt me. In the ardor of sport, in the excitement of a violent exercise, the roughest shock will hardly be felt. Every very intense sensation, we also know, provokes convulsive movements, sudden and violent muscular contractions. These movements are not mechanically determined by the sensation; they are produced voluntarily, although they will not remove the cause of the pain, at least to mitigate its effect. The howling of the wounded dog, the squirming of the worm that is cut in two, are a voluntary effort to escape suffering.

If the same pain recurs frequently, the animal soon remarks that some among these vague movements will contribute more directly than others to assuage it, and will give the preference to them. The habit of resisting a particular suffering by a special movement, becoming hereditary, forms a veritable instinct. In conformity with the general laws of evolution, there is established a selection between injurious and useful reflex actions, and the latter will gradually predominate.

Even when we are not suffering from any accidental uneasiness provocative of special muscular reaction, we are impelled to move by the simple need of motion. Every animal has to expend daily a more or less considerable sum of energy to procure food for itself. The oyster, fixed on its rock, imbibes, without effort and almost passively, the vegetable matter which the waves bring to it. A snail, drawing itself slowly along on its belly, easily reaches the leaves which are in its way. The ox marches, step by step, in the field for hours, feeding upon the grass-leaves with which its lips come in contact. A wolf has to make journeys of leagues every day in search of its prey. The swallow has to keep in incessant motion to procure enough insects to satisfy its appetite. To the necessity for eating is added that of escaping enemies, and this exacts an increase of activity from the animal. Thus, each one, according to its kind, is obliged to be in motion more or less every day, and is organized for it. If, through accidental circumstances, its activity ceases to be useful, it is nevertheless obligatory upon it, for its physical constitution, having become adapted by heredity to the normal life of the species, can not abruptly bend itself to other conditions of existence. Its organism continues to furnish it the same quantity of energy, which it has to expend in some way. Hence the movements of the captive animals—of the lion which paces its cage, and of the canary-bird that leaps from bar to bar. Hence the physical exercises with which persons whose occupation condemns them to a too sedentary life relax themselves. This necessity for motion is especially great in youth, because the young animal must train itself in all the movements it will have to perform at a later age, and must also exercise its muscles and joints to develop them. Thus every animal has a tendency daily to expend a certain quantity of force, which is determined, not by the accidental wants of the individual, but by the general wants of the species.

How is this expenditure regulated? By what criterion do we know when we need exercise? A matter so indispensable to the good working of our organization can not be the product of reflex action. It is evident that animals can not take exercise by rule, after the manner of a gentleman who imposes upon himself the

obligation of taking "a constitutional" every evening. Even man can do this only exceptionally. Our intelligence permits us to satisfy these physiological exigencies in a more rational manner; but it does not give us notice of them. What would become of the most reasonable being in the world if he had to depend upon his reason to tell him what he needed? A real necessity exists for us to be warned by special sensations.

We sometimes dispose of this explanation cheaply by speaking as if we had direct knowledge of our strength. Nothing could be more simple were this the case. Strength accumulates in us while we are inactive, ending by giving us a painful sense of nervous tension, which prompts us to expend our excessive energy in certain exercises. We go through these first as a relief; then, our reserve force having been exhausted, we feel our strength failing, and the need of repose comes upon us. There would be no considerable objection to speaking in this way if our purpose was simply to indicate a correspondence between our muscular sensations and the dynamical state of our muscles. But we must take care not to believe that there is the shadow of an explanation in it.

What is it that takes place in us during that period of repose when we say that energy is accumulating in us? Our muscles are undergoing restoration, are getting into a condition to form new chemical combinations. But I have no knowledge how much force they can expend at a given moment; it exists in them in a purely virtual condition. I do not feel it any more than I feel the expansive force of the powder contained in a certain flask, or the heat that may be disengaged from a particular piece of charcoal. We have not, therefore, any degree of consciousness of our disposable energy. The anticipatory sensation which we feel just as we are about to make a movement, and which we take for a consciousness of the force we are going to expend, is only a preconceived imagination of the sensation of effort that will accompany the contraction. Even at the instant when the contraction is effected our sensation of effort only indicates to us the extent of the actual tension of our muscles. It answers so little to the real expenditure of our energy, that it would be exactly the same if we should stretch them in that way without performing any work. We shall therefore have to give up these conventional explanations and regard matters more closely.

When we have continued still for a long time, we feel, first, a great desire to move. Like all our appetites, the inclination to move is recognized, even before any sensation can give us cognizance of it, by the effect which it produces on the imagination. In unconscious hunger or thirst, we think, not precisely that it would be agreeable to drink or eat, but that some broiled chicken

or a pot of beer would be very nice. So the young man who has been confined too long dreams of canoeing and horseback-riding; before thinking that those exercises will do him good, he pleases himself with representing them to himself. This desire, as it defines itself, becomes more intense; and, if it is opposed, intolerable. At the same time physiological phenomena become apparent, augmenting the uneasiness. A process of nutrition and reintegration is carried on in the muscle during rest. The products of combustion, or the molecules that form stable compounds, are eliminated and replaced by fresh combustible matter, or unstable compounds. The muscle is then in what Rosenthal calls the sensitive condition. The most minute spark will bring on an explosion; the slightest impression will provoke violent reflexes. In such a state we feel nervous, as it is called; or can not keep still. The expression is exact. Our sensitive condition requires the spontaneous movements which the mere idea of motion provokes. A typical example of such suffering from forced rest is afforded by the pupil waiting for school to be dismissed. He feels as if his back was breaking and his legs were growing stiff. When will the bell ring? He wishes with a frantic inclination that he could jump from his seat, shout, and run. He wriggles and drags his feet on the floor. A hard look from the teacher fastens him to his place, and he quiets himself; but what a punishment it is to endure it!

Motion also procures a positive physical pleasure for us. When we give ourselves up to an exercise, or go at anything with great energy, all the functions are accelerated, the heart beats more rapidly, breathing becomes more frequent and deeper, and we experience a general feeling of comfort. We live more, and are happy in living. Rapid and boisterous movements produce also a kind of intoxication and giddiness that have a peculiar charm.*

"Let us imagine," says M. Guyau, "what are the feelings of a bird as it opens its wings and glides through the air like an arrow; let us recollect what we ourselves have experienced in being carried by a horse at a gallop, or upon a boat dipping into the hollows of the waves, or in the whirl of a waltz; all these motions evoke in us the undefined idea of the infinite, of unbounded longing, of superabundant and careless life, a vague rejection of individuality, a craving to go without restraint, to be lost in immensity; and such vague ideas enter as an essential element in the impression which a great number of movements cause us." The observation is correct; but I believe that this kind of pantheistic intoxication is at bottom only a cerebral congestion. A horse,

* The modern infatuation for round dances is chiefly explained by this intoxication of dizziness. It is shown in children at a very early age.

plunging into a rapid gallop, and seeing a large void space opening out in front of him, will never fail, as the saying is, "to do himself up." The mere rapidity of his motions gives him vertigo; he loses sight of danger; and when an obstacle suddenly rises against him, if he does not jump over it, he breaks himself against it. So, all rapid movements deprive us of complete possession of ourselves; we go on, we follow our impulse. It may be a foolish one; so much the better. Go on! up! quicker! What is such behavior but sheer intoxication?

To the physical pleasure of motion is added a moral and emotional pleasure. In like manner as it helps us to escape from physical suffering, muscular activity may serve as a remedy for disappointments, for moral pains. We weep and struggle when we have a great grief, as well as when we are suffering from a physical wound. The most afflicted man forgets his trouble while he is performing a vigorous exercise. Byron had his boxing-gloves brought to him, and went through his accustomed practice with a servant, while his mother was being buried; but the servant felt that his touch was stronger than usual, and all at once he threw down his gloves and fled to his room. Who has not felt the necessity of what is called throwing off his grief? When we remain quiet our mind is, as it were, bent back upon itself, and all the pains that can affect us are augmented, as it were, by the very attention which we give them. In action we forget ourselves, directing our thought to the attainment of the purpose upon which we are fixed.

Physical exercises also give us positive mental pleasures, the chief among which is the satisfaction of our self-love. When I execute any movement, or devote myself to an exercise, I try to get as much as possible out of it. I want particularly to acquit myself better than any one else, and have a feeling of pride when I have succeeded. This leads to a real increase of ardor, and a luxury of physical activity. Observe youth who are indulging themselves in any sport together; is not emulation the essential principle of their activity, which enables them to expend all they have of available energy? Tell a child to run as long as he can; he will stop in a short time, out of breath. Give him rivals, and the fear of being left behind will prevent his feeling fatigue and provide him with unaccustomed nervous resources, and he will go till his strength is exhausted. It is a recognized rule with all couriers, gymnasts, canoeists, etc., that one should not train himself alone in exercises of speed; there should be at least two, to excite one another by competition. Some persons have tried to show that the pleasure of play is disinterested. They are speaking without knowledge. When we are playing, we are entirely occupied with the result of our activity. We may not be very

particular in the choice of the end we shall seek; we may not care whether that end is worth the trouble we are taking; but, for all that, we may not be willing to have our faculties at work for nothing. We fix upon some end that we shall reach. If I take a walk, I say that I am going here, or there, or will walk so many miles. If I play a game of skill, I want to win, to make so many points, to accomplish something; I am not, then, seeking merely the pleasure of acting, but I try to reach a result agreeable in itself. Games of chance have no attraction if one is not interested in the play. Sometimes, this interest is conferred by the hope of a material or pecuniary profit; most frequently in the pursuit of the honor of having won. But, is working for glory disinterestedness? Pascal's analysis was more complete. The hunter loves to hunt, not only for the pleasure of walking in the fields in pursuit of a hare, not only for the pleasure of bringing his game home, but chiefly for the proud joy of exhibiting it. It may be said that this is all vanity; that the object is not worth the pains it has cost. But that matters not to the argument. I do not say that play is an affair of well-defined interest; but that we are excited in it by considerations of interest. At the moment when I am striving to arrive at that end, I do not measure its importance, I do not think of the reasons that first started me; there is the goal I have proposed to myself, and I run for it. If the thought occurred to me for an instant that this was all futile, only a pretext, my ardor would be cooled down at once. It is also easily seen that, when we engage in any exercise or game, we by a mental effort exaggerate the importance of the end sought. If we play billiards with a strong adversary, we call it a match, and hire a hall; and the players please themselves by imagining that they are staking their reputation on each carom-shot. A game of chess becomes very dramatic, and the player's hand trembles when he makes a decisive movement. When we start on a canoeing excursion, it pleases us to imagine for the moment that we are going to travel into distant regions. Walking in the forest, we say that we are exploring the country, and are going to make discoveries. In this way we try to satisfy the spirit of adventure that the usages of our too well regulated society have not wholly stifled. It is, therefore, an essential quality of play that, to take pleasure in it, we must mount the imagination, and fancy that what we are doing on a small scale is done on a grand one; must substitute mentally, for the futile activity in which we desire to be absorbed, some mode of superior and more fascinating activity. Tell me that I am willfully fooling myself, if you please. Tell me even that I have a secret consciousness that it is an illusion, and that I am more than half a dupe of the pretext that I have given myself. It is nevertheless true that the pleasure of action for the

sake of action is not enough, and that I take interest in the game only so far as my self-love is seriously interested in it. It is still necessary for me to have a difficulty to overcome, a rival to surpass, an advance to make. In dismounting from a horse, in taking off our skates, in putting away our oars, we congratulate ourselves that we have become stronger, and we feel an imperious necessity for telling of our prowess. We should take less pleasure in a game of skill if we could not convince ourselves after each essay, and convince some one else, that we had become more adroit in it. Every exercise in which one is decidedly a past master inspires a vague distaste.

We are able also to determine, in every physical exercise, a particular kind of pride. Very simple or childish, if you please, but all the deeper and more instinctive—that which one feels in conquering the forces of nature. We delight to refuse what they solicit us to do, and to accomplish what they seem to forbid. Hence the pleasure felt in climbing a hill, putting down an obstacle, leaping a ditch, and walking against wind and rain. In canoe-sailing we would rather stand close to the wind than be carried with it, and prefer running over the waves to flying before them. Of all these forces we struggle most earnestly against and most delight to overcome that of gravitation. It binds us to the earth by fetters which we are anxious to unloose, and inflicts disabilities upon us and exposes us to dangers that we are glad to escape. Motions of speedy transport are pleasant, because they relieve us for the moment from the burden of the feeling of inertia. Hence the agreeableness of riding, driving, cycling, spring-board jumping, vaulting, and riding in an express train. There is a charm in dreaming that we are leaping immense distances and prolonging the bound by the force of the will alone. In the struggle against height, falling is defeat; equilibrium is the defensive; motion of simple translation is the beginning of enfranchisement; and movement upward is triumph.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

THE Niagara-studies of Prof. Julius Pohlmann have led him to predict that, after the falls have receded one mile—or in two thousand years—there will be but one fall, the American fall having disappeared, and its islands will be represented by low hill-tops on a peninsula projecting from the American shore; but the fall will be nearly two hundred feet high. After a recession of three miles more, there will be again two falls at the foot of Grand Island, the Canadian fall being the larger. The height of the falls will thereafter diminish thirty-five feet for every mile they travel south; and long before they have receded twelve miles, or to the southern end of Grand Island, they must disappear entirely as falls, and present only a long series of rapids. The second American fall will recede more slowly than the Canadian fall, but will ultimately be reduced to the same condition, forming a river with swift-flowing current and perhaps a few short rapids.

THE HISTORY OF THE FORK.

By J. VON FALKE.

THE Duchess of Beaufort, dining once at Madame de Guise's with King Henri IV of France, extended one hand to receive his Majesty's salutation while she dipped the fingers of the other hand into a dish to pick out what was to her taste. This incident happened in the year 1598. It demonstrates that less than three hundred years ago the fingers were still used to perform the office now assigned to forks, in the highest and most refined circles of society. At about this time, in fact, was the turning-point when forks began to be used at table as they are now. When we reflect how nice were the ideas of that refined age on all matters of outer decency and behavior, and how strict was the etiquette of the courts, we may well wonder that the fork was so late in coming into use as a table-furnishing. The ladies of the middle ages and the Renaissance were not less proud of a delicate, well-kept hand than those of our own days, and yet they picked the meat from the platter with their slender white fingers, and in them bore it to their mouths. The fact is all the more remarkable, because the form of the fork was familiar enough, and its application to other uses was not uncommon. It was even used in cooking in the epic period of the middle ages, as a spitting instrument, though rarely as an aid in cutting. It appears with some regularity in the inventories or treasure-lists of kings and noble houses after the fourteenth century, but only in isolated or very few specimens as compared with the large numbers of knives and spoons. In Clement of Hungary's list in the fourteenth century thirty spoons are mentioned, but only one fork, and that of gold. The proportion is nearly the same in the Duke of Anjou's inventory of 1360. King Charles V of France in 1380 listed along with many other objects two silver forks with crystal handles; and this monarch is said to have had in all twelve forks in a million francs' worth of silverware. The Duchess of Touraine in 1389 had only two forks to nine dozen spoons. The instrument was then called by the same name it bears to-day in French—*fourchette*—and this was the diminutive of *fourche*, pitchfork, with which all the farmers at least were acquainted. Forks are not oftener mentioned, nor for a different purpose, in the fifteenth century; but Duchess Charlotte of Savoy had, in 1483, two spoons and a fork, of silver, "to eat comfits with."

These examples show that forks were known as rare and costly articles, but were not used for the purposes they now are. Among the miniature pictures on Anglo-Saxon manuscripts are representations of meals, but none in which a fork is shown lying on the

table or held in the hands of any of the guests—except that, in a single picture in a manuscript of Herrad of Landsberg (since destroyed by fire), an instrument resembling a fork, but more like a double-edged knife split in the direction of its length, was lying on the table.

The fork is likewise not mentioned in any of the numerous descriptions of feasts by the chroniclers of the middle ages; not in Alienor de Poitiers's account of the ceremonies and table usages of the Burgundian court; nor in the account of the setting of the table given in the "Ménagier de Paris"; nor in that of the great feast given by the Duke of Burgundy to the English ambassadors in 1462. But it does appear from these stories that the guests took the meat and other viands which the carver prepared for them, and carried it to their mouths in their fingers. In some distinguished houses they took the pieces out of the common dish, or cut them themselves to eat them by the aid of their fingers. The guests did not even receive separate knives, and it was the custom in England in the sixteenth century for each to bring his own knife and sharpen it upon a common steel that hung upon the wall.

The absence of forks explains the careful attention that was paid to washing the hands before and after meals. Servants were all the time going around with basins and pitchers, and a towel slung over their shoulders, and pouring water on the hands of the guests, and the napkins were frequently changed. Sometimes the water was perfumed; and every pains was taken to remedy the soiling of the fingers that inevitably took place, and make it as little unpleasant as possible.

It seems clear enough, in the light of this negative evidence, that the few forks included in the silver-ware of the middle ages were not used as forks are used to-day. Since kitchen-forks served as spits and for holding roasts, it is probable that the high-born lords and ladies of those times, who only appear to have possessed these implements, used their silver forks for toasting their bread at the breakfast-room fire. There is some direct evidence that they were employed to hold substances particularly disagreeable or inconvenient to handle, as toasted cheese, which would leave an unpleasant smell; or sticky sugared dainties; or soft fruits, the juice of which would stain the fingers.

Only one incident is related of the use of the fork in the nineteenth-century fashion. This was by a noble lady of Byzantium who had married a Doge of Venice, and continued in that city to eat after her own custom, cutting her meat very finely up and conveying it to her mouth with a two-pronged fork. The act was regarded in Venice, according to Pietrus Damianus, as a sign of excessive luxury and extreme effeminacy. It suggests a probability that the fashion of eating with forks originated at the imperial

court of Byzantium and thence extended to the West. Some hundreds of years had still to pass before it could be domiciliated in Europe, for this Byzantine doge's wife lived in the eleventh century, while the fashion of eating with forks did not become general till the seventeenth century.

It was the duty of the waiters to deposit the meats with large, broad carving-knives upon the plate, from which the guest took it and broke it up with his fingers, and with them conveyed it to his mouth. The nails were also sometimes called into requisition, if we may credit the verses which read—

> "Ongle, riche et précieux;
> Ongle qui tranche, quand tu veux;
> Ongle qui en lieu de forcettes
> À la belle sert de pincettes."
>
> [Nail, rich and precious;
> Nail, that cuts when you will;
> Nail, which, in place of forks,
> For the fair dame plays at tongs.]

Meat, when not cut with the carving-knife, was taken up in the fingers. It was the rule with respect to other viands for which the hand had to be put into the dish, to take them always from the same side, so that each guest might have his particular spot to pick from. A polite man should pick meat neatly with three fingers, and should take care in conveying it to his mouth not to touch his nose with it (*"Ne touche pas ton nez ci main nue, dont la viande est tenue"*). Erasmus, of Rotterdam, who was versed in good manners, said in 1539: "Take what is offered you in three fingers, or present your plate to receive it. There are people who can hardly wait till they have sat down before putting their hand into the dish; one must receive on his plate whatever he can not take out with his fingers." Monsignor della Casa, Bishop of Benevento, wrote in 1544 a kind of manual of etiquette entitled "Galatea," which was published in a French translation by Jean de Tournay in 1598. Among other things it directs: "One ought not to wash his hands before everybody, but in his room, not in society. Nevertheless, when one is sitting at table, he should wash his hands in the presence of the others, even if it is not necessary, so that those with whom he puts his hand into the dish may know that it is clean. A well-bred man," continues this author, "will avoid greasing his fingers, lest he soil the table-cloth, which would be disagreeable to those who witnessed it. It is also not proper to wipe the fingers with the bread which one is about to eat." The practice of some persons, of eating only with gloved hands, does not seem strange in the light of these facts.

As has already been remarked, the change from fingers to forks began to be made at about the end of the sixteenth and the begin-

ning of the seventeenth centuries. An evidence of it may perhaps be found in the silver-list of Gabrielle d'Estrée in 1599, which included twenty forks. There was a society of fops connected with the court of King Henri III of France, who were distinguished for their ultra-refined notions concerning manners and dress, and were called *Mignons*. The king himself, who invented a new kind of starch for his collars, was in sympathy with them. The ways of this circle were ridiculed in a satirical pamphlet called the "Island of the Hermaphrodites," which was published in the earlier years of the seventeenth century. The custom of eating with forks was held up to scorn in this publication; stress was laid upon the accidents that it was presumed would happen to those who had not become adepts in the use of the instrument; and it was thought funny that, when it came to washing the hands after eating, they should be found not to have been soiled.

The custom seems to have extended by way of Italy to Germany, France, and England. Coryate, an English traveler, relates in his "Crudities," published in 1611, that he had thought it best to follow the Italian fashion of cutting meat with the aid of the fork, not only while he was in Italy, but also in Germany, and even after he had returned to England. "The Italians and also many foreigners residing in Italy," he says, "use a little fork when they cut meat at their meals. While they cut with the knife, which they hold in one hand, they hold the meat firm in the dish with the fork, which they hold in the other hand; and any one who should unthoughtedly touch the dish from which they were all eating, with his fingers, would give offense, and be accused of violating good manners."

The fork did not rapidly come into general use, even in the higher ranks. An English writer, Heylin, mentioned it in 1652 as something that had been taken up by the elegants. It is remarked in a "Nouveau traité de la civilité, qui se pratique en France parmi les honnestes gens" ("New Treatise on Civility as it is practiced in France among Well-bred People"): "When one takes from the dish, he should wait till his superiors have been served; he should also select once for all what he is to take, for it is impolite to put the hand into the dish twice, and still more so to move it around seeking for piece after piece." Louis XIII adopted the fork, but his queen, Anne of Austria, who had been brought up at the Spanish court, never could accustom herself to it, and always used her fingers, although she was very proud of her pretty hands. A verse is cited from the "Muse historique" in 1651, which indicates that departures from the old fashion of eating were still exceptional at the French court; and a pair of verses, of about the same period, contrast the old way with the new.

One of the most active agents in introducing the fork to polite

society was the Duke of Montausier, who was a constant visitor at the Hôtel Rambouillet, the seat of the most refined manners of the day, and married the daughter of the marquise of that name, Julie d'Augennes. This house was of Italian origin, and probably received the fork along with its other Italian heritages. The duke, as the first chamberlain of King Louis XIV, had excellent opportunities, which he improved, to introduce the fork among the aristocracy and make its use common.

The history of the fork after the middle of the seventeenth century chiefly concerns the extension of its use and its spread from the aristocracy to humble circles of society. Its form has also been gradually improved, and changed from that of the straight, two-pronged instrument of the olden time, of little use except as a spit, to the gracefully and conveniently curved, broad, many-pronged English fork of the present day, spoon-like in shape, and precisely adapted to its purpose.—*Translated for the Popular Science Monthly from Ueber Land und Meer.*

SKETCH OF CAROLUS LINNÆUS (CARL VON LINNÉ).

WHATEVER may be the future progress of the sciences of botany and zoölogy, Prof. Flower has said, in the British Association, "the numerous writings of Linnæus, and especially the publication of the 'Systema Naturæ,' can never cease to be looked upon as marking an era in their development." In the "Systema Naturæ," the speaker added, the accumulated knowledge of all the workers at zoölogy, botany, and mineralogy, since the world began, was collected by patient industry, and welded into a complete and harmonious whole by penetrating genius.

CAROLUS LINNÆUS, afterward called Carl von Linné, was born at Rashult, in the parish of Stenbrohult, in the province of Smaland, Sweden, May 13, 1707, and died at Upsala, January 10, 1778. He was the eldest child of Nils or Nicolas Linnæus, commissioner and afterward pastor of the parish, and Christina, the daughter of the previous incumbent. The father was versed in natural history; a well-stocked flower-garden was attached to the house; and the child, hearing his father talking about the virtues of certain of the plants, at four years of age became interested in them, and formed the habit of asking about the names and qualities of all that he saw. The father, as a condition of further answering his questions, insisted that he should remember all that he had been told before. The child thus received a valuable mnemonic discipline that served him through life, and was familiar from the start with the Latin and the vernacular names of plants. His

mother used to relate that he could always be soothed, when crying, by giving him a flower. When seven years old he was put under the private tuition of Telander, a teacher of only the ordinary stamp, and three years later was sent to Wexiö to school, his father wishing to prepare him for holy orders. The story was the same at both places. He made no progress in the routine studies of the course, except in mathematics and physics, but used every opportunity to look after flowers and turn over books of botany. With Gabriel Hök he did a little better, for that teacher allowed him some liberty to gratify his tastes; but the people at the gymnasium were again troubled by his perversity. Finally, the father and the teachers held a consultation, and it was decided that, although his moral record was unexceptionable, he offered no promise as a scholar, and must learn a trade. So he was, or was about to be, apprenticed to a shoemaker, when the father, having some bodily malady for which he had to visit Dr. Rothman, spoke incidentally of the trouble Carolus was giving him. The doctor thought the boy might succeed in medicine and natural history, and offered to take him to board, and help him in his studies. He gave him private lessons in physiology, and introduced him to Tournefort's botanical system, by the aid of which Linnæus continued to study the local plants. At the end of a year, Linnæus was sent to the University of Lund, recommended as his private pupil by Hök, who, taking great liberties with the facts, substituted his own good opinion for the curious letter with which the principal of the gymnasium had armed the candidate. This letter was to the effect that pupils might be compared to young trees in a nursery: there would sometimes be some that would grow up wild in spite of all the care that might be spent upon them, but which might still do well if transplanted to a different soil. "It is with such a hope that I send this youth to your institution, where, perhaps, another atmosphere may favor his development." At Lund, Linnæus found employment as a copyist with Dr. Kilian Stobæus, Professor of Medicine and physician to the king, who had a museum of minerals, shells, and dried plants. The professor was not at first aware of the kind of treasure which he had in his house; but Linnæus, having formed a friendship with a fellow-student who had access to the doctor's library, borrowed books from it and sat up till late in the night reading them. Mother Stobæus observed the light in his room, and, being worried about danger from fire, warned her son of it. He detected Linnæus at his reading; but the explosion and subsequent explanations resulted in a widening of the young man's opportunities for pursuing his favorite studies. On Rothman's advice, Linnæus determined to go to Upsala, where the advantages seemed to be better than at Lund. The three hundred francs that he was able

to take with him were soon exhausted, and he was reduced to poverty, having, it is said, to wear other students' cast-off shoes, or mend his own with paper, when Olaf Celsius, Professor of Theology, observed his attention to botany, looked at his collections, and concluded that he would make a good assistant on the "Hierobotanicon," a treatise on the plants of the Bible, which he was preparing. He took Linnæus to board, gave him the free use of his library, found him some private pupils, and recommended him to Olaf Rudbeck, Professor of Botany. Linnæus had in the mean time had his attention directed to the sexuality of plants, by reading a letter from Burckhart to Leibnitz, a review of an address by Vaillant, and a work by Wallin, all bearing on the subject. He himself wrote a treatise on the sexes of plants, and it was this that Celsius made the occasion for the introduction. Rudbeck's advanced age did not permit him to attend personally to all his lectures, and he made Linnæus his deputy. The hand of the struggling student, who now at last, in his twenty-fourth year, saw his career taking an upward direction, was soon visible also in the remodeling and restocking of the academic gardens—he having become director in a place where his application to be employed as a subordinate had been refused a year before.

His equivocal position at the university having become unpleasant by reason of the jealousy it excited among the professors, Linnæus accepted a proposition from the Academy of Sciences of Upsala to make a scientific exploration of Lapland. He accomplished this task in the summer of 1732, depending mostly on his own resources, and, in the face of great difficulties and with no little danger, accomplishing a journey of forty-six hundred English statute miles, and brought home from it valuable fruit in knowledge and specimens. In 1734, after having been defeated by the hostility of one of the professors in an attempt to resume his lectures at Upsala, he performed, attended by seven pupils, a similar exploration of Dalecarlia. While on this journey, he lectured at Fahlun, to large audiences, and determined, at the suggestion of Chaplain (afterward Bishop) Browalius, to attend a foreign university for the degree of M. D. This would give him a position in society and science.

Arriving at Hamburg, he exposed the spurious character of a seven-headed hydra in a museum there which was composed of weasels' heads artfully sewn together, and so offended the proprietor of the establishment that he was obliged to leave the city at once. At Hardewijck he passed his examination, defended a thesis on the cause of intermittent fevers, and received his degree from the university. At Leyden he called upon Gronovius, who, upon being shown the "Systema Naturæ," was so delighted with it that he undertook to publish it at his own expense. The great

physician Boerhaave, after some delay, gave him a cordial reception, and recommended him to Burman, at Amsterdam, with whom he stayed a year. Here he accepted an invitation from the wealthy banker Cliffort, who had a great garden and fine library at Hartekamp, and stayed with him three years, living at ease, working in the library and garden and at his studies and his books, and sparing no pains, through the "Hortus Cliffortianus," and his description of the banana, *Musa Cliffortiana*, to make the fame of his patron lasting.

In 1736 Linnæus visited England, bearing a letter of introduction from Boerhaave. He was received by the botanists there with a reserve which soon thawed and gave place to warm appreciation. Returning to Holland, he completed the printing of his "Genera Plantarum," finished arranging and describing Cliffort's collection of plants, spent a year with Van Royen at Leyden, rearranging the garden, and in 1738 started for Sweden by way of Belgium, Paris (where he formed a lasting friendship with Bernard de Jussieu), and Rouen. Hence he sailed direct for Sweden, intending to establish himself in the practice of medicine at Stockholm. Patients were slow in coming to him, and in his discouragement he said that "if he had not been in love he certainly would have left his native country." His fame, however, which had become conspicuous abroad, had at last reached Sweden, and he gradually obtained a practice, was appointed naval physician, Professor in the School of Mines, etc., and was able to marry the daughter of Dr. Moræus, who had waited for him for several years. He enjoyed the support of influential friends—Marshal the Baron Charles de Geer and Count Tessin—and by their aid succeeded, in 1741, in reaching the summit of his ambition—a professorship in the University of Upsala, which he occupied for thirty-seven years. His fame grew rapidly. "He was long a center to which all important researches in natural history were reported. Numerous disciples attended his lectures and propagated his doctrines verbally, while his own works, scattered abroad, made his system and his reforms popular. His correspondence was extensive, and his letters, many of which have been preserved, exhibit his character in the most favorable light. On his recommendation, the Swedish Government intrusted several young men with distant scientific missions. Among the most distinguished of these travelers were Ternstroem, who traversed the East Indies and died at Poulo Condor, in the China Sea, in 1743; Kalm (whence the name of our mountain laurel, *Kalmia latifolia*), who explored North America from 1747 to 1751; Hasselquist, who visited Smyrna, Egypt, and Palestine, and died in Smyrna in 1752; Osbeck, who explored China from 1750 to 1752; and Loeffling, who traveled in Spain in 1751 and South America, where he died in 1756."

The numerous works of Linnæus appeared now in rapid succession, and honors and invitations came to him. He declined a liberal offer from the King of Spain to settle in that country; purchased the estates of Sofja and Hammarby, at the latter of which he built a museum of stone; was made a Knight of the Polar Star, and in 1761 received a patent of nobility, antedated to 1757, in deference to which he Gallicized his Latin name, inserted a *von* in it, and became Carl von Linné. The last reward was, however, not for his scientific achievement, but was granted in recognition of his having devised a way to improve the quality of the pearls of the fresh-water mussels of Sweden. When sixty years of age, Linnæus's memory began to fail; in 1774 he suffered an apoplectic attack; two years later he lost, by another stroke, the use of his right side; and he died of a hydropsy in 1778. While all the academies of Europe made him their associate, and princes gave him the most striking marks of their consideration, still "in the simplicity of his life he was little accessible to the honors of the world. Living with his pupils, whom he treated as if they were his children, some singular plant, or some animal varying a little from the ordinary form, would give him more joy than anything else. He was never troubled by the attacks of his antagonists; and although he had some distinguished ones—Haller, Buffon, and Adanson—and they frequently treated him unjustly, he was never at the pains of replying to them. . . . His society was charming, and all who came in contact with him conceived a tender attachment to him. His only weakness seems to have been a too great fondness for praise. Strongly attached to religion, he never spoke of the Deity but with respect, and embraced with marked pleasure the numerous occasions which natural history offered him to declare the wisdom of Providence."

The publications of Linnæus are described under more than one hundred and eighty titles. The earliest in date was the "Hortus Uplandicus," or list of cultivated plants of Upsala, in which he first outlined his plan for classifying plants according to their organs of reproduction—stamens and pistils—which appeared in 1731; and the last was his "Plantæ Surinamenses," 1775. The period of his literary activity thus lasted forty-four years. His great merits were the introduction of a system of botanical classification which, though wholly artificial and unnatural, served as an efficient tool till a philosophical system, based on affinities, could be worked out, and the extension and general application of an exact system of nomenclature. He sought to cover the whole domain of nature, and therefore wrote on minerals, animals, and plants. In mineralogy he paid particular attention to the forms of crystals, and based his classification on them. In zoölogy he looked to the organs of mastication and digestion,

to the feeding, to the wings in birds, and to the presence or absence of elytræ in insects. But his distinction rests pre-eminently on his work in botany, and to this most of his publications relate. He was not the originator either of the sexual system of classification or of the binary nomenclature; for the former, as we have seen, was suggested by other students whose essays he read and whose ideas he put in practice; and the latter was applied, as has been shown in a sketch in a previous number of the "Monthly," nearly two hundred years before him, by Pierre Bélon. But Linnæus made it general and established it in science. The formal introduction of his system of classification was made in the "Systema Naturæ," which Gronovius published at Leyden in 1735, in three sheets, according to one authority, or in eight folio sheets, according to another. It was enlarged in successive subsequent editions, of which the twelfth appeared during the author's lifetime. It was followed in 1736 by the "Fundamenta Botanica," of twenty-six pages, which contained an exposition of the author's theory as worked out after seven years of study and the examination of eight thousand plants. This work, amplified, afterward developed into two—the "Bibliotheca Botanica," Amsterdam, 1756; and the "Classes Plantarum" or "Systemata Plantarum," Leyden, 1738; while a more detailed explanation of the system of nomenclature was given in the "Critica Botanica," Leyden, 1737. These three works were the beginning of the great reform in botany; but the doctrine of Linnæus on these subjects, co-ordinated in its parts and illustrated by examples, was reproduced as a whole in 1751 in the "Philosophia Botanica," Stockholm—a work which served as the foundation for most of the minor treatises till Linnæus's artificial system of classification was supplemented by the natural system. The "Genera Plantarum," 1737, gave full descriptions of the genera, "according to the number, shape, position, and proportion of all the parts of fructification," and is pronounced by Mr. B. Daydon Jackson, in the "Encyclopædia Britannica," "a volume which must be considered the starting-point of modern systematic botany." In the "Species Plantarum," 1753, "the author's most important contribution to scientific literature," the trivial names expressing some obvious character to designate species are fully set forth.

The nomenclature introduced by Linnæus has endured, and the names he gave to species are still living; so that "in whatever part of the world one may be, if there are botanists or professional gardeners, there it is enough to give the Linnæan name of a plant to have its identity understood at once." His system of classification has given way to the more philosophical natural system by affinities based upon comparison of all the parts and qualities of the plant. There is reason to believe that he foresaw

this, and regarded his system as simply a stepping-stone to something better. He is quoted as having said that whoever should found a natural system on a solid basis would be his great Apollo. An account in the "Philosophia Botanica" of a series of naturally allied families is prefaced by the words that "a natural method is the first and last thing to be desired in botany; Nature does not make leaps. All plants show affinity on either side, like the territory in a geographical map." He and Bernard de Jussieu corresponded on the subject, and the latter urged him to institute a natural system. Such a system, however, could not be built at once, or by one man, and Linnæus had to content himself with furnishing the staging by the aid of which others could more slowly build up the permanent structure.

Linnæus is described as having been a little above the medium height, rather slight, but well shaped; with broad head and frank and open physiognomy; lively and piercing eyes, with a peculiarly refined expression. He was quick-tempered, but soon recovered from his passion. "He lived simply, acted promptly, and noted down his observations at the moment. . . . He found biology," says Mr. Jackson, "a chaos; he left it a cosmos. When he appeared upon the scene, new plants and animals were in the course of daily discovery, in increasing numbers, due to the increase of trading facilities; he devised schemes of arrangement by which these acquisitions might be sorted provisionally, until their natural affinities should have become clearer. He made many mistakes; but the honor due to him for having first enunciated the true principles for defining genera and species, and his uniform use of trivial names, will last so long as biology itself endures."

Another biographer gives as the peculiar features in which he surpassed, "the distinct study he made of each species, the regularity and detail of the characteristics he gave of genera, the care which he took to put in the background variable circumstances like size and color, the energetic precision of his language, and the convenience of his nomenclature."

A scheme was started for erecting a monument to Linnæus in connection with the centenary of his death. As is usual in such affairs, the subscriptions were slower in coming in than was contemplated by the promoters of the enterprise, and the completion of the monument was delayed. The statue, by Prof. Kjelberg, was unveiled on the 13th of May, 1885. It stands in the Humlegården in Stockholm, and represents the "flower-king," as he is called in Sweden, at the age of sixty years, in a meditating attitude, holding the "Systema Naturæ" and a bunch of flowers in his right hand. It is surrounded by allegorical female figures representing botany, zoölogy, medicine, and mineralogy.

EDITOR'S TABLE.

THE DOMAIN OF SCIENCE.

A FEW months ago one of our contributors had occasion to notice the attacks made upon the scientific tendencies of the age by writers who might have been supposed to be themselves highly qualified representatives of the general scientific movement. In these columns, too, we have ourselves found it necessary, from time to time, to maintain the position that, if all is not well in the world to-day, it is not because we are troubled with too much science, but because we have as yet too little. Science has reduced to tolerable order certain departments of thought and knowledge; but there are whole sections of life that as yet it has barely touched. So long as this is the case, the social body must suffer. Until the true laws of life are discovered, and set in such a light as to command obedience, there must be more or less of confusion, distress, and waste of effort. It is evident, therefore, that the duty which lies at the door of every one capable of grasping the situation is to do all in his power to help science to have its perfect work—its work of social reorganization and regeneration.

Many persons, we are persuaded, fail to understand that science has any application outside of the investigation of physical laws. They think of it as something that has to do with astronomy and geology, with physiology and chemistry, with steam-engines and telegraphs and telephones. They do not think of it as a method of research valid in every department of life, and coextensive with the whole reach of human knowledge. The time has come, however, when the claims of science to be the supreme mistress of thought and action can not be too boldly or earnestly advocated. The spirit of science is a spirit of order; wherever, therefore, there is disorder, science is lacking, or, at least, exercises but imperfect control. We see the perfect control of science in the exactness with which astronomical observations and predictions are made; we see it in the wonderfully accurate determinations of the chemist; we see it in the formulæ of the electrician. When we come to the so-called science of medicine we see real science struggling for the mastery and too often overborne by ancient prejudice and lazy empiricism. When we come to education, we see an enormous parade of technique, but, on the whole, poor results in the way of disciplined intellects and harmonious characters. When we ask how science is applied to the government of individual lives, we find that it is scarcely so applied at all. Some notions of physical hygiene are more or less diffused throughout the community, at least among the more intelligent classes; but how rarely do we discover any clear recognition of the fact that there is such a thing as moral hygiene, the object of which is happiness just as that of physical hygiene is health! To "minister to a mind diseased" is now, as long ago, an almost desperate task, but to prevent the formation of morbid habits of body or mind is, or should be, quite within the scope of the science of to-day. Dr. Maudsley, in his very interesting work on "Body and Will," gives copious illustrations of the gradual progress of moral and intellectual decline through successive generations. Inordinate vanity or selfishness in one generation may mean a decided development of mental or moral insanity in the next. It is consequently of the utmost importance to watch and resist the very beginnings of evil, seeing that it is impossible to say what these may lead to if allowed to

gather force. Much may be done by each individual to promote and strengthen his own mental soundness by exercising control over his casual thoughts. "Were anybody," says Dr. Maudsley, "to observe carefully what goes on in his mind during waking, he would perceive that it was the theatre of as many fantastic, grotesque, incoherent thoughts as in dreams. . . . Obviously it will depend much on the occupation that each one gives his mind, and on the habits of attention and thought that he has trained it to, how large a part these incoherent vagaries of thought shall play in his waking mind, and in some degree in his dreams also. . . . Now, if it be thus possible by good and regular exercise of the higher faculties of mind to gain some mastery over thought in dreams, how much more is it within our power, and shown to be our duty, to obtain and exercise dominion over the vain and evil thoughts, inclinations, and imaginings of the day, and so hinder their luxuriant growth!"

In the ordinary conduct of life much that is harmful would disappear if life were once regarded as something that should and must be brought under scientific rules. Feelings, opinions, actions may all be brought to a scientific test—that is, to the test of outward reality—or, in other words, of conformity to our necessary environment. With some people it is enough to say that they *feel* so and so: their feelings are assumed to be unalterable, and to carry their own justification with them. Such a temper is not far removed from the hysterical, and, if it should assume that unhappy character some day, the result should not be considered surprising. The human being who persistently looks inward rather than outward for guidance, and makes more of his or her subjective impressions than of the teaching of objective facts, is in an unstable and dangerous condition. Again, in the matter of opinions, some persons esteem it a precious privilege to be able to think and believe, as they say, whatever they please. Their opinions they regard as their property, which no one must venture to trespass on. But the true test of opinions, it is needless to say, lies not in conformity to personal inclination, but in their agreement with some established order of things. It is folly to talk of believing whatever we please; if we are rational people at all, we believe *as we must*. Reason constrains us, and we have really no choice. In regard to actions there is perhaps a more general feeling of responsibility; and yet even here how much we are inclined to trust to hap-hazard! How little we keep before us a rational scheme of life, or steady, uniform principles of action! The very man who would sink in his own estimation if he played a card unscientifically in a game of whist, will play many a card most unscientifically in the much greater game of life. Why? Because, while he believes in a science of whist, he does not believe in a science of life. He studies the laws of whist, but does not study the laws of life. Yet science is prepared to step in and shed a clear light upon every department of human duty. All that science needs as a basis is a fixed order of things. Such a fixed order is discoverable in human nature and its environment. Here are facts, and every fact yields its own lesson. The time, we have no doubt, will come when men will see that life is a network of cause and effect, and that trouble does not spring out of the ground, nor promotion come at hap-hazard from the east or the west, but that whatever "happens," as the expression is, has its own adequate antecedent. But why should we not hasten the coming of that time by proclaiming —those of us who believe in it—the efficacy of science for the direction of individual and social life?

That science lays claim to the region of politics is evident from what has been said, but that it is conspicuously

absent from that region is evident from —the newspapers. So long as we understand by politics merely a scramble for office, so long will there be a very slight and indirect relation between political action and the general welfare; but it rests with an intelligent community to bring its politics up to a higher plane of a constant striving after social and economic harmonies and the realization of justice in all human relations. We are only able on this occasion to glance at one or two points of our subject; we think, however, that the lesson we would impress is sufficiently obvious. Science is not merely a thing of machinery and apparatus; it is not confined to the measurement of material forces or the explanation of physical phenomena. It is a method for the observation and co-ordination of facts and the forecasting of results; and wherever facts are to be found there Science is prepared to establish her kingdom. The unwise flout her pretensions, preferring the worship of Chance and Caprice; but the wise will range themselves on her side and strive to set up her peaceful reign, the benefits of which they know will extend to all, and increase from age to age.

THE TORONTO MEETING OF THE AMERICAN ASSOCIATION.

For the third time in its history the American Association this year peacefully invaded Canada, with hearty repetition of former hospitalities at the hands of Northern friends—indeed, hospitalities were so abounding as to encroach a little upon the serious work of the meeting. Receptions, official and social, followed one another in quick succession, and excursions were organized to Niagara Falls, Muskoka, and the Sudbury mines. The local committee is to be congratulated on its appointment of Prof. Charles Carpmael as chairman; he is Director of the Toronto Observatory, and the weather during the week was therefore delightful. Canada is proving very attractive of late years as a meeting-place for American scientific organizations; its latitudes are a guarantee for comfort in vacation months, and its new railroads have developed immense tracts of the highest scientific, economic, and scenic interest. It promotes international amity that Americans and Canadians at work in the same fields of research should gather in the same rallying centers, and, as a consequence, form the friendships of men having aims in common. In crossing the border an American finds himself amid differences, social and political, sufficiently marked to make his visit instructive — differences, nevertheless, not so pronounced that he can persuade himself to regard Canadians as a foreign people.

Prof. T. C. Mendenhall, Superintendent of the United States Coast and Geodetic Survey, was the presiding officer at the Toronto meeting. His ability and tact won him golden opinions on all hands. The addresses of the vice-presidents of the Association to their various sections were excellent—with one exception, which does not call for more specific mention. Prof. George L. Goodale, of Harvard, chairman of the Biological Section, delivered an address on protoplasm, treating his theme chiefly from the standpoint of vegetable histology and physiology—the field of science in which he is the leading American authority. General Garrick Mallery, of the Bureau of Ethnology, Washington, chairman of the Anthropological Section, made Israelite and Indian the subject of his address. He showed their parallelism in planes of culture, in methods of government, social observances, and religious faith. General Mallery's address will be presented in "The Popular Science Monthly" at an early date. Prof. H. S. Carhart, of the University of Michigan, Ann Arbor, as chairman of the Physical Section, gave a lucid presentation of theories of electricity.

Describing the experiments of Prof. Hertz, of Carlsruhe, and other investigators, he declared it certain that all radiant energy is transmitted as electromagnetic waves in luminiferous ether. In the Chemical Section, Prof. W. L. Dudley, of Vanderbilt University, Nashville, chose amalgams as his subject. His treatment was clear and suggestive, but of necessity technical. Mr. R. S. Woodward, mathematician to the United States Geological Survey, Washington, presided over the section of Mathematics and Astronomy. His address on mathematical theories of the earth was a successful endeavor to make clear to hearers, scientific and unscientific, the history of a theme usually wrapped up in the rigid mummy-cloths of mathematical formulæ.

Among the more noteworthy contributions to the various sections we may mention, in Section A, the paper of Prof. J. R. Eastman, of the Washington Observatory, on stellar distances. He argued that no relation exists between the magnitudes, distances, and proper motions of stars. Prof. Charles Carpmael made a plea for numbering the hours of the day from one to twenty-four, abolishing the necessity for writing A. M. and P. M. The plan has been adopted by the Canadian Pacific Railway on its Western and Pacific divisions. In accordance with Prof. Carpmael's suggestion, the Association memorialized the Governments of the United States and Canada, of the various States of the Union, and provinces of the Dominion. Much interest was developed in the exhibition of the Hastings achromatic objective, one of the notable gifts of mathematical and mechanical science to astronomy. It promotes accuracy of definition twenty-three per cent, and eliminates spherical aberration. In Section B, Prof. Thomas Gray, of the Rose Polytechnic Institute, Terre Haute, gave an experimental demonstration of methods of electrical measurement. Dr. George F. Barker, of the University of Pennsylvania, reviewed recent improvements in electrical storage batteries. He showed the immense advance in efficiency gained in the newest batteries based on the Planté model. In Section C, Mr. Charles E. Monroe, of Newport, R. I., gave the results of investigation into the explosiveness of celluloids. He had found the opaque variety insensitive to a shock of detonation at ordinary temperatures, while translucent celluloids were readily exploded by this means. Mr. O. Chanute, of Chicago, who has made the subject a specialty, gave an account of the best methods for preserving timber. After discussing the question of weights and measures, Section C passed a resolution urging colleges of pharmacy and medicine to adopt the metric system. Before Section E, the Society of American Geologists held a session, at which Prof. James D. Dana, of Yale, took occasion, in the light of new geological discoveries, to revise certain of his former teachings respecting areas of continental progress. Among his suggestions in nomenclature was that Ontarian be substituted for Silurian in local geological phraseology. In Section E, Rev. H. C. Hovey, of Bridgeport, Conn., described the newly explored pits of remarkable depth in the Mammoth Cave of Kentucky; the whole series of pits being connected by a magnificent hall several hundred feet in length. Mr. R. T. Hill, of the State Geological Survey of Texas, read several excellent papers on the general features of Texan geology, on the Eagle Flats of the mountainous region of Texas, the ancient volcanoes and Staked Plains of the State. In Section F a good many papers of value were read —all, however, technical in character. Prof. C. V. Riley, entomologist to the United States Department of Agriculture at Washington, contributed a paper on the best methods of subduing injurious insects by intentional importation of their natural enemies. Much interest

was developed in Toronto in entomology through the large attendance of entomologists from all sections of the country. An Entomological Club was formed, and Washington is to be its first meeting-place, but no date for meeting was named at Toronto. Mr. T. J. Burrill, of Champaign, Ill., read an interesting paper on the fermentation of ensilage. Section H was more than usually strong this year—the leading officers of the Bureau of Ethnology being present in force. The antiquity of man was discussed from opposed points of view by Mr. W J McGee, of Washington, and Dr. C. C. Abbott, of Trenton, N. J. Mr. W. H. Holmes, of Washington, contributed an interesting paper on the evolution of ornament, as illustrated in the ceramic and textile art of the North American Indians. Mr. W. J. Hoffman, also of Washington, described the secret societies of the Ojibwas, which enjoy as elaborate a ritual of initiation, and as sharply defined gradations of rank, as any modern order among the pale-faces. Rev. Dr. Bryce, of Winnipeg, Manitoba, depicted the Winnipeg mound region, the most northerly district where mounds have been discovered on the North American continent.

In Section I, Mrs. N. S. Kedzie read a sensible, thorough-going paper on scientific cookery. Prof. A. G. Warner's paper on luxury was an able and discriminating discussion of the difficult question, How much of income may be justly expended on luxuries? Prof. B. E. Fernow, the chief of the Forestry Division, United States Department of Agriculture, Washington, made a strong plea for the extension of governmental control to forests, irrigation, water-courses, and the like. His ground was that in these matters individual interests are often opposed to the general good, and that the state alone can represent national interests with comprehensiveness and continuity. At Prof. Fernow's suggestion the Association passed a resolution recommending to Congress an early and earnest consideration of a sound forestry policy.

While the press and people of Toronto promoted the success of the meeting by hearty and intelligent co-operation in its work, by cordial and multiplied hospitalities, the question naturally occurs, What did the Association do for Toronto in presenting science in such wise as to interest and instruct popular audiences? The first public lecture was delivered by Mr. C. K. Gilbert, Assistant Director United States Geological Survey, on the geology of Niagara River; it was both appropriate and timely, coming as it did on the eve of an excursion to the great cataract. Dr. H. Carrington Bolton gave the second lecture, an admirable illustrated account of a recent visit to Mount Sinai. Interest, however, was of course centered in the address of the retiring president, Major J. W. Powell, chief of the United States Geological Survey. In his unavoidable absence, the address was read for him. Its topic was the evolution of music, from dance to symphony. We regret to say that it disappointed the vast audience which had assembled to hear it. Major Powell has made important fields of exploration and research his own; had he chosen a theme which could have been illuminated by his special knowledge, we feel certain that he could not only have interested but charmed the thousands whom his fame drew together in Toronto. Section I, the Section of Economics and Statistics, affords, in a larger measure than any other, an opportunity for the presentation of questions having popular interest, and eliciting instructive discussion. An increased recognition of this fact at the hands of the Council of the Association seems to be desirable.

The next meeting of the Association is to be held in Indianapolis, and is to commence August 20th. Its officers will be Prof. George L. Goodale, Cambridge, Mass., president. Its vice-presidents: Section A, S. C. Chandler, Cam-

bridge, Mass.; B, Cleveland Abbe, Washington; C, R. B. Warder, Washington; D, James E. Denton, Hoboken, N. J.; E, John C. Branner, Little Rock, Ark.; F, C. S. Minot, Boston, Mass.; H, Frank Baker, Washington; I, Richards Dodge, Washington.

LITERARY NOTICES.

THE PHILOSOPHY OF NECESSITY; OR, LAW IN MIND AS IN MATTER. By CHARLES BRAY. Third edition. Longmans, Green & Co. 1 vol. 12mo. Pp. 407. Price, $1.75.

THE readers of George Eliot's "Life," as related in her letters and journals, will recall her intimacy with the Bray family. In Chapter II of that work Mr. Cross speaks of her acquaintance with and admiration for Charles Bray, mentions the book whose title is given above (which was first published in 1841), and adds that her association with the author and his family "no doubt hastened the change in her attitude toward the dogmas of the old religion." With Mr. and Mrs. Bray, and the latter's sister, there existed on the part of Miss Evans "a beautiful and consistent friendship, running like a thread through the woof of . . . thirty-eight years."

It would be an excellent thing if the reading public could be induced more often to turn back to the works of those who have carefully thought out the problems of existence, rather than to demand new expressions which are apt to be more crude and superficial. Did they but know it, they would not seldom find a greater degree of novelty in the old than in the recent. And the republication of books which have commanded attention, but which, though excellent, are in danger of being forgotten in the multitude of novelties, is a highly commendable enterprise.

Among such works of a past generation is "The Philosophy of Necessity," by Charles Bray. It aims to justify the doctrine of the uniformity of nature as construed by the necessitarians and utilitarians, of whom the Mills and Bentham are the type. The author treats the subject first on the side of moral and then of mental science. The best part is the first division, wherein there is a very able and valuable discussion of the origin, objects, and advantages of evil, pain being considered "as the necessary and most effectual guardian of that system of organization upon which happiness depends." Mr. Bray is no pessimist. On the contrary, he believes fully in the beneficial quality of pain, that evil is only a means to good, or good in the making. The limitations of human knowledge prevent us from seeing this clearly, but an hypothesis to that effect furnishes the only rational explanation of the existence of suffering in the world. The moral universe is governed by law, and its laws "are as stable as those of the physical world"; and, while "the causes of many evils must still remain unexplained," enough is known to warrant the faith that "further knowledge will make manifest the benevolent tendency of all creation, and bring home to every heart the all-cheering conviction that 'whatever is, is right.'"

THE GARDEN'S STORY; OR, PLEASURES AND TRIALS OF AN AMATEUR GARDENER. By GEORGE H. ELLWANGER. New York: D. Appleton & Co. Pp. 345. Price, $1.25.

THE author of this work is an "amateur" in the sense that he has a genuine love for the gardener's occupation; his knowledge of the subject and familiarity with plants and their relations with soil, situation, weather, climate, and purpose, are professional. His essay is practical in the sense that one may learn from it well how to manage a garden with the greatest success, what plants to put in it, where to put them, how to arrange them, and how to treat them. It is to an equal extent æsthetical, for it is permeated with the sense of the beautiful and of whatever is pleasing to a refined taste, and draws freely for illustration on the world's stores of poetry. Hence, whatever be the purpose of the reader who takes it up, he will find something respondent in it. The particular design of the volume is to direct attention to the importance of hardy flower-gardening as a means of outward adornment and a source of recreation; to present a simple outline of the art rather than a formal treatise or text-book of plants—"to stimulate a love for amateur gardening that may be carried out by all who are willing to bestow upon it that need of attention it so boun-

tifully repays." Having dwelt upon the plans for the garden as revolved in anticipation during the storms of March, the author gives "An Outline of the Garden," or a discussion of its general arrangement, the selection of plants, and the provision of stock. Among the first objects to be looked after are "the spring wild flowers," which have been too much neglected heretofore, but are beautiful, easily got, and (a great many of them) easily cultivated. From the attention given to the daffodil, we judge it to be a decided favorite with the author. In successive chapters are discussed "The Rock Garden," the "Summer Flowers," "Two Garden Favorites" (the lily and the rose), "Insect Visitors," "Hardy Shrubs and Climbers," flowers "In and Out of the Garden," "The Hardy Fernery," "Midsummer Flowers and Midsummer Voices," "Flowers and Fruits of Autumn," and the "Last Monk's-hood Spire," the variegated colors and the poetry of the closing season. Nearly all the plants referred to are such as may be successfully grown in the lower lake region, and have for the most part come under notice in the author's garden.

HISTORY OF HIGHER EDUCATION IN SOUTH CAROLINA, WITH A SKETCH OF THE FREE SCHOOL SYSTEM. By OGDEN MERIWETHER. Pp. 247.—EDUCATION IN GEORGIA. By CHARLES EDGEWORTH JONES. Pp. 154.—HISTORY OF EDUCATION IN FLORIDA. By GEORGE GARY BUSH. Pp. 54.—HIGHER EDUCATION IN WISCONSIN. By WILLIAM F. ALLEN and DAVID E. SPENCER. Pp. 68. Washington: Government Printing-Office.

THESE monographs constitute numbers 4, 5, 6, and 7 of the series of "Contributions to American Educational History," which the United States Bureau of Education is publishing, under the editorial supervision of Prof. Herbert B. Adams, in its "Circulars of Information." In the first paper of the group, South Carolina is shown to have been active at a very early period in promoting the mental development of its youth. Schools were founded and maintained by the State government and by private and charitable aid; and youth were sent to England to school, who on their return gave new impetus to the movement. The tardiness of the growth of colleges gave occasion for the development of a good system of academies, and training schools were brought within the reach of all. The first college was founded in 1785. At present, every religious denomination of any strength in the State is represented by its college, and attendance at most of the institutions is gradually increasing. In the main, they "follow the average college course, but, owing to want of funds, they can not offer many electives." The strongest and most famous institution is South Carolina College, which had as its president for fourteen years Thomas Cooper—a rash predecessor of Huxley and the evolutionists in the scientifico-religious discussion—and Francis Lieber as a professor for twenty years. Both of these eminent men were strong in political science, and under their influence the college gained a high reputation as a center for the study of that and correlated branches. The instruction of the negro population was well attended to during the earlier part of the history, and until, in 1834, an act was passed forbidding them to be taught. An entire change has come over the educational aspect since the war, of which due notice is taken in the history. Mr. Jones begins his sketch of "Education in Georgia" with notices of the schools that existed during the colonial epoch; then tells of the formation and conduct of academies after the Revolutionary War; and continues with a review of the elementary education afforded in the rural schools, an account of the "poor-school system," its rise, development, and decay; and a history of the beginnings of the general system of schools for whites, the application of which was interrupted by the war. The thread of the history is resumed after the war, and the present condition of the schools and colleges is described. Technological education has been made prominent, with results that are declared very satisfactory, at Emory College; the industrial department at Clark University is highly organized; and special emphasis is laid on the industrial education afforded at Atlanta University. Morris-Brown College, with two hundred and eleven pupils, is wholly under the charge of colored people. Mr. Bush's essay does not treat of the higher education alone in Florida, but sets forth in addition the growth and development of the school system of the State. It

particularly emphasizes the rapid advance made in all educational matters during the last decade. Since 1880, "each year has chronicled a steady advance, and the aggregate results will bear favorable comparison with the educational statistics of any other State. The superintendent has been able to report a gratifying progress in nearly every particular: in the growth of the schools in public favor; in the increased number of schools and school children; in improved buildings and enlarged funds; in a more intelligent and better instructed body of teachers; in a lengthened school year; and in a ratio of attendance which, if correctly reported, probably can not be surpassed in any of the older States." Messrs. Allen and Spencer's "Higher Education in Wisconsin" is the first of a series of monographs on the group of Northwestern States in the angle between the Ohio and the Mississippi Rivers. It gives only a general outline of the career of each of the colleges, mostly compiled from the sketches in their alumni records and similar publications. The larger share of space is given to the State University. The five private colleges are described as to the leading features and character of each and the scope and tendency of their work; and brief notices of three others are given. The execution of all these histories might be improved upon. Mr. Meriwether's on South Carolina shows the most painstaking, but it is considerably short of what such a work ought to be.

COMMERCIAL ORGANIC ANALYSIS. By ALFRED H. ALLEN. Second edition, revised and enlarged. Vol. III, Part I. ACID DERIVATIVES OF PHENOLS, AROMATIC ACIDS, TANNINS, DYES, AND COLORING MATTERS. Philadelphia: P. Blakiston, Son & Co. Pp. 431. Price, $4.50.

ANALYSTS will welcome the third installment of this comprehensive and carefully prepared work, which details the properties, methods of proximate analytical examination, and assaying of the various organic chemical substances employed in the arts, manufactures, and medicine. The material has so increased during revision that it will occupy at least double the space of the original two-volume edition. The part now issued consists of a chapter on aromatic acids, with an appendix descriptive of the tannins, and a chapter on dyes and coloring matters. The material relating to the latter subject is almost all new, coloring matters having been represented in the first edition only by sections on picric acid and basic anilin derivatives. In the present edition these substances are treated under the following ten divisions; nitro and nitroso coloring matters, aurin and its allies, phthaleins, azo coloring matters, rosanilin and its allies, safranines and indophenols, coloring matters from anthracene, sulphureted and unclassified coal-tar dyes, and coloring matters of natural origin. There remain to be treated in the second part of Vol. III, which will complete the work, organic bases, cyanogen compounds, albuminoids, etc.

STELLAR EVOLUTION AND ITS RELATIONS TO GEOLOGICAL TIME. By JAMES CROLL. New York: D. Appleton & Co. Pp. 118. Price, $1.

MR. CROLL in this book presents what he calls the "Impact Theory" of stellar evolution—a theory which, as applied to our sun, supposes that it was formed from a hot gaseous nebula, produced by the colliding of two dark stellar masses. The stars, being suns like our own, in all likelihood had a similar origin. He believes that this theory, which was proposed as a hypothesis some twenty years ago, has been strengthened by the astronomical and physical facts that have accumulated since that time. The hypothesis does not exclude the nebular theory, but rather includes it, and enlarges it by supposing what was in the world previous to the nebulæ. It assumes that previous to their formation there were stellar masses in motion; that the motion was in straight lines, and, as to each mass, without reference to the existence of any other; that two or more of these masses would casually collide; and that the collision would result in the breaking of them up, with the production of heat, and the rebounding of the fragments upon one another would end with the resolution of the whole into a nebula of inconceivably high temperature, whence the universe has been evolved, as supposed by Laplace's hypothesis. Here is an unlimited source for the energy possessed by the sun and solar system, to which the only conceivable alternative is gravitation. The latter is held to be inade-

quate to account for the amount and intensity of the energy. There are cited as supporting the impact theory, or as illustrating it, the meteorites, which may be residual portions of some of the original solid bodies; comets, for which a similar origin may be supposed; the motions of the stars, which are of greater velocity than can result from gravitation; the facility with which the theory will explain nearly every feature of the nebulæ; and binary stars, sudden outbursts of stars, and star clusters. An argument is based on the insufficiency of the gravitation theory to account for the heating of the primary nebula, while the "impact theory" furnishes at once a sufficient origin for it; and another, which is styled "a crucial test," on the requisitions of geological time as dependent on the antiquity of the sun's heat. It is mathematically demonstrable that, if gravitation be the only source from which the sun derived its heat, life on the globe can not date further back than twenty million years; and attempts have been made to measure the geological ages by this rule. Mr. Croll argues, from the evidences afforded by the amount of denudation that has occurred, and its calculated rate, and by biological development, that the processes which have taken place can not be subjected to such limitations. Further light is cast upon the theory by citations from the views, or consideration of questions suggested by them, of Prof. A. Winchell, Mr. Charles Morris, Sir William R. Grove, Sir Benjamin Brodie, Dr. T. Sterry Hunt, Mr. William Crookes, Prof. F. W. Clarke, and Dr. G. Johnstone Stoney, on the prenebular condition of matter.

DARWINISM: AN EXPLANATION OF THE THEORY OF NATURAL SELECTION, WITH SOME OF ITS APPLICATIONS. By ALFRED RUSSEL WALLACE. London and New York: Macmillan & Co. Pp. 494. Price, $1.75.

THIS work treats of the origin of species on the same general lines as were adopted by Darwin, but in the light of the discussions, objections, theories, and new discoveries that have been brought forth in the nearly thirty years which have elapsed since Darwin promulgated his great principle. The objections made to Darwin's theory in its earlier days were fundamental, and were directed against the principle itself. But Darwin "did his work so well that 'descent with modifications' is now universally accepted as the order of Nature in the organic world; and the rising generation of naturalists can hardly realize the novelty of this idea, or that their fathers considered it a scientific heresy to be condemned rather than seriously discussed." The objections now made to the theory apply solely to the particular means by which the change of species has been brought about. The objectors seek to minimize the agency of natural selection, and to subordinate it to laws of variation, of use and disuse, of intelligence and heredity. Mr. Wallace maintains the overwhelming importance of natural selection over all other agencies in the production of new species. He begins with illustrating the struggle for existence, which he considers one of the most important and universal, and yet least understood, forces of Nature. Next, variability is shown to be constant, universal, incessant, and frequent. It was a weakness in Mr. Darwin's argument that he based it so largely on the evidence of domesticated animals and plants. Mr. Wallace goes to Nature, and finds variation just as much the rule with species in the wild state, illustrating the fact with numerous citations and diagrams; and the objection that the preponderance of chances is immensely against the right variation or combination of variations occurring just when required, is blown away by showing that all forms of variation are all the time occurring. The argument is continued as to the relations of crosses, color, mimicry, heredity, and the geographical distribution of organisms. The objection based upon the failure to find evidences of the existence or former existence of a great number of the connecting links, which the theory of evolution supposes must have been developed, is answered by showing that the geological record of former forms is, and always will be, very imperfect, particularly with reference to animals and plants of the upland; and good reasons are given to show why it must be so. The views of Mr. Spencer, as set forth in his "Factors of Organic Evolution," and of Prof. Cope, Dr. Karl Semper, Prof. Geddes, and Prof. Weismann, are taken up, and claimed not materially to diminish the importance of natural selection, or to show that any of the laws or forces to which they

appeal can act otherwise than in strict subordination to it. In application to man, Mr. Wallace finds natural selection ample to the development of his physical structure, but failing to account for his moral and intellectual faculties.

THE ENGLISH SPARROW IN NORTH AMERICA, ESPECIALLY IN ITS RELATIONS TO AGRICULTURE. Prepared under the Direction of Dr. C. HART MERRIAM, Ornithologist, by WALTER B. BARROWS, Assistant Ornithologist. Washington: Government Printing-Office. Pp. 405.

THIS monograph is published as "Bulletin No. 1" of the "Division of Economic Ornithology and Mammalogy" of the Department of Agriculture, and is designed to communicate the evidence from first hands respecting the character of the English sparrow, and its desirability or otherwise as a denizen of our own country. We have persecuted the hawk and the owl and the crow with guns and bounties and poison. Farmers' boys have lain in wait to shoot the robins and cat-birds that came to their cherry-trees. The ladies of the civilized world have thousands of agents in all countries, the United States included, hunting birds to obtain the wherewithal they may decorate their hats. One of our choicest amusements is to hunt for the mere sake of killing; and an amateur sportsman boasted the other day in a newspaper of having killed a thousand birds in a week, which, having no use for them, he gave to the farmers on whose land he poached. The first impulse on seeing a strange bird is to kill it. At last, after the birds had been exterminated in our large cities and made rare in the country at large, sparrows were introduced as a partial but certainly inadequate and unsatisfactory remedy for the mischief that had been done by rashly disturbing the balance of nature. As soon as they became numerous they were accused of driving useful birds away. There are unquestionably too many of them, and they multiply too fast; they are quarrelsome and tyrannical; and they are inefficient insect-destroyers as compared with the species we have allowed to be nearly exterminated. Whether or not they assist man in driving other birds away is a question of fact. The present report contains answers from thirty-three hundred persons in the country at large respecting the character and habits of the sparrow. The answers, mostly dated in 1886, represent all sorts of views, and are often contradictory. There is no means of estimating the relative value of the testimonies. The witnesses against the sparrow preponderate in numbers; but among those in its favor many are known to be accurate and intelligent observers. Mr. Nicholas Pike, who introduced them, an accomplished naturalist, is sure that they exterminated the measuring-worm from the trees of Brooklyn; and his testimony will be corroborated by all persons whose recollections run back far enough to compare the summer appearance of that city, with its trees bare as if a fire had swept through them, before the sparrows came, with the luxuriant foliage they obtained after the birds had worked a year or two upon them. There are many other testimonies to the destruction of insects by sparrows; but other birds are better at the business. Many equally intelligent and trustworthy witnesses, while admitting their quarrelsomeness, deny that the sparrows drive other birds away. Some of the States have recently passed laws to prevent the further destruction of song and plumage birds. Where these laws are enforced, the desirable birds are coming back, and the sparrows are not keeping them away. Man, not sparrows, is the enemy they have the most reason to dread.

THE JOURNAL OF MORPHOLOGY. Edited by C. O. WHITMAN, with the Co-operation of EDWARD PHELPS ALLIS, JR. Vol. II, No. 3, April, 1889. Boston: Ginn & Co. Pp. 250, with many Plates.

THE "Journal" has fixed a high mark, both in the quality of its articles and in the style of setting them forth, and adheres to it. The present number contains a study of the "Uterus and Embryo of the Rabbit and of Man," by Charles Sedgwick Minot; "The Anatomy and Development of the Lateral Line System in Amia Calva," by Mr. Allis; "The Organization of Atoms and Molecules," by Prof. A. E. Dolbear; "Some New Facts about the Hirudinea," by Mr. Whitman; and "Segmental Sense-Organs of Arthropods," by William Patten.

WHAT MOSES SAW AND HEARD; OR, THE IDEA OF GOD IN THE OLD TESTAMENT. By A. O. BUTLER. Chicago: R. R. Donnelley & Sons. Pp. 434.

IN this book a study is made of the character of the material surroundings in which the authors of the Old Testament were placed, and the nature of the impressions upon them which the Church regards as revelations from Deity, and which they describe as the voice of God speaking to them, or as appearances in a vision or a dream. It involves also an inquiry into their psychological condition. In the chapters on "The Bible as it is" and "The Publication of the Pentateuch," the author's conclusions respecting the origin and dates of the books agree in the main with those of the school of criticism represented by Kuenen. The inquiry is continued in chapters on "The Idea of God in Creation," "What Moses saw and heard," and "The Spirit of Inspiration." It is held that Moses saw the presence of God in the lightning or the fire, and heard his voice in the clouds; and the agency of God in the work of creation was the divine spiritual fire which the author of Genesis saw flashing in the clouds. Those who reject this construction may still find the interpretation of his expressions in the motion which God by his word, or by some power in himself, in the first instance communicated to matter. This suggests to the author the inquiry whether the writer of the first chapter of Genesis and the twentieth chapter of Exodus did not know that light was only a mode of motion.

AN INTRODUCTION TO THE LOCAL CONSTITUTIONAL HISTORY OF THE UNITED STATES. By GEORGE E. HOWARD. Vol. I. Development of the Township, Hundred, and Shire. Baltimore: Publication Agency of the Johns Hopkins University. Pp. 626.

THIS work forms an extra volume of the "Johns Hopkins University Studies in Historical and Political Science." In it a subject is treated which, although it has been a very important feature in the development of the American colonies and the organization of our States, has received but little systematic attention. It is only recently, in fact, that the matter of local governmental organizations has been formally considered by historians and political students. But, since Freeman began publishing his historical studies, the theory of an English local constitution, coeval in origin with that of the race, has become familiar; and, as the investigation has been extended, such a constitution has been found to have been a characteristic feature of Aryan civilization. Nowhere has local self-government played a more important part than in the development of our own American institutions, and it has become common with publicists to assign to it the origin of some of the most precious features of our system of government. As the author of this work remarks, in describing the New England town-meeting, "it is difficult to see, without the township, how the Englishman could have triumphed over the Frenchman in the struggle for the control of the continent; it is no less difficult to understand how, without it, the English race in America could have grown into an independent nation." The development of the various forms which local government has assumed in the United States is traced back to its beginning, and the modifications they have undergone are followed. Their origin lies far back in the history of the race. In this light are described the evolution of the township, hundred, and shire or county, with their various aspects, their divisions, and their combinations. The book is intended simply as a general introduction to the study of the subject, and leaves room for special treatment in different localities. But it points out "a rich field in which many laborers may find profitable employment," and which it would be well to have carefully cultivated.

Numbers Universalized, by *David M. Sensenig* (Appletons' Mathematical Series: D. Appleton & Co.), is intended as an advanced elementary algebra, which will be made part first of a higher algebra soon to be completed. It is thus bound separately in order to meet the wants of such schools as have arranged a higher course in algebra than is outlined and treated in the author's first book, "Numbers Symbolized," and yet have not time enough devoted to this branch to complete a full course in higher algebra. It is especially adapted to schools preparing students for college, and to advanced classes

in high and normal schools. While too great simplicity in treatment has been avoided, care has been taken to preserve the logical sequence of thought and to prevent the discussions from becoming unnecessarily abstruse and difficult. Examples have been selected with special reference to variety in combination and methods of reduction.

In his *Graduated Course of Natural Science* (Macmillan) Mr. *Benjamin Loewy* endeavors to place the fundamental facts of physics and chemistry upon a purely experimental basis. The principal subjects usually embraced by a school course in these branches are arranged in a progressive manner, "so that the pupil may be able to proceed gradually from that which is known, simple, and easy, to that which is unknown, complex, and difficult; from that which is near and within a young learner's perception, to what is more recondite." It is also a part of the plan to give no instruction but that which is conveyed through experiments and the immediate consequences of the phenomena observed, as deduced by a chain of simple reasoning. The present volume (Part I) of one hundred and fifty-one pages comprises the first year's course for elementary schools and the junior classes of technical schools and colleges.

The First *Report* of Mr. *John C. Smock* (Charles Van Benthuysen & Sons, Albany), *On the Iron Mines and Iron-Ore Districts in the State of New York*, is based in part on the answers by managers of mines to letters of inquiry addressed to them, and partly on a personal survey of the mining district. Nearly all the mines were visited, and notes of their geographical situation and geological relations were obtained. The answers to letters of inquiry furnished valuable data, especially in the relations of the mines to the iron-mining and iron-manufacturing industries of the country. Short notices of the older mines and of some of the abandoned mine localities have been incorporated in the report. The paper is published as "Bulletin" No. 7 of the New York State Museum of Natural History.

The *Report*, by Dr. *George M. Dawson*, *on an Exploration in the Yukon District, Northwestern Territory, and adjacent Northern Portion of British Columbia*, gives the results of an expedition made in 1887, in the vast and hitherto almost unknown region in the extreme Northwest of British America. The tract in question is bounded on the south by the sixtieth parallel, forming the northern line of British Columbia, on the west by Alaska, on the east by the Rocky Mountains and the one hundred and thirty-sixth meridian, and on the north by the Arctic Ocean. It derives its name from its lying within the drainage-basin of the Yukon River. It has an area of about one hundred and ninety-two thousand square miles, or nearly equal to that of France, greater than that of the United Kingdom by seventy-one thousand square miles, ten times that of Nova Scotia, and nearly three times that of the New England States. The report is accompanied by a map of the district and northern British Columbia, in three sheets.

Geonomy and Cosmonomia (J. B. Lippincott Company) presents theories on the origin of ocean currents and the growth of worlds and cause of gravitation, by *J. Stanley Grimes*, who is also the author of theories in mental physiology that have been favorably mentioned by such authorities as Dr. McCosh, the Rev. Joseph Cook, and the late Dr. G. M. Beard, and of a new view of the nebular system. In *Geonomy* he sets forth that the continents originated in the sinking of the ocean basins beneath weights of sediment, accompanied by compensatory upheavals, and were shaped by six pairs of elliptical oceanic currents, the sedimentary deposits of which caused the sinkings. In *Cosmonomia* the condensation of ether is presented as the cause of the growth of worlds and of gravitation.

Mr. *H. H. Johnston's History of a Slave* presents a dark aspect of affairs in Arabo-savage Africa. The author, who has acquired fame as an explorer, and particularly as the leader of an expedition for ascending Mount Kilimanjaro, has attempted in it to give a realistic sketch of life in the western Soudan. The story is the outcome of some of his own experiences, and is especially based on what he has seen and heard when traveling in North Africa, in the Niger Delta, and on the Cross River. It does not describe any particular series of events as they actually occurred, but combines isolated incidents such as are not unknown in the country into a connected, consecutive

story—or, to use the words of the author, he has pieced together the accounts given him by negro slaves in the Barbary states and in western equatorial Africa. Some of the incidents have been actually witnessed by him during some one of his journeys. The persons and places named are of real existence, as are also the languages quoted. The story is illustrated by forty-seven full-page pictures, from original drawings by the author—true delineations of African life and scenery, most of which have been done in Africa from actuality. No concoctor of fiction could invent a more tragic story than this one of a real life which is still happening every day.

The eighth issue of the *Annual Index to Periodicals* (W. M. Griswold, Bangor, Maine) is brought down to July, 1889. It contains the lists of titles of articles and authors, in the notation peculiar to Mr. Griswold's indexes, for twenty-five American and foreign periodicals.

Under the title of *The Two Great Retreats of History*, Ginn & Co. publish in a single volume, where they can be read comparatively, Grote's account of the Retreat of the Ten Thousand Greeks, taken from his history of Greece entire, except for a few verbal changes; and an abridgment of Count Ségur's narrative of Napoleon's retreat from Russia. The book is designed for school use, and is furnished with maps, an introduction to each section, and explanatory notes by "D. H. M."

The *Popular History of California*, by *Lucia Norman*, is published by the Bancroft Company, San Francisco, in a revised and enlarged second edition. The first edition, published in 1873, was well received. The "enlargements" bring the story down to the present time. The history of this State presents a considerable variety of incident. It includes periods of discovery and of colonization by the Spaniards; of the prominence of the missions; of the Mexican War and the conquest of the country by the United States; of the discovery of gold and the gold-hunting excitement; of filibustering and vigilance committees; and of agricultural and horticultural development, in which, rather than in gold, California seems destined to find the true source of its wealth.

Three language-studies of different character, each having its peculiar value, are published by Ginn & Co. The *Practical Latin Composition* of Mr. *William C. Collar* sets forth a method of teaching which has been satisfactorily tried by the author after breaking with the traditional method, and which rests on the principle that the exercise should be based upon the very words of some Latin author. These words furnish him a living model, in which he must find all his material—order, words, idioms, and constructions—and in which he must observe all the points wherein the structure varies from that of his own tongue. He is expected to familiarize himself first with the Latin passage and the details and peculiarities of its construction, and then to execute his exercise, reproducing the words and constructions, but with many changes of form, and in altered combinations; and to refer to the original only for correction and verification.

Next in the group is the *Pages choisis des Mémoires du Duc de Saint-Simon*, in preparing which Mr. *A. N. Van Daell* has been actuated by the belief that the study of a foreign language ought to bring students in contact with the master-minds of foreign nations. Too few of such works are accessible to ordinary students. Among the desirable ones is that of Saint-Simon, which "is one of the landmarks of French literature. "The selection of such a book as this for class use presupposes a certain degree of maturity on the part of the student. The editor has taken no other liberties with the text than to omit, "as the occasion required," unsuitable expressions or sentences. Notes—all in French—are furnished, explaining difficult expressions and making various points more clear.

The third of Ginn & Co.'s linguistic publications is the translation of the Anglo-Saxon poems, *Elene*, *Judith*, *Athelstan*, and *Byrhtnoth*, by *James M. Garnett*. The translations were made in the course of class work, are critical, and are based on carefully revised editions. "Elene" relates to the search for the true cross by the Empress Helena; "Judith" is a version of the Hebrew legend; and "Athelstan" and "Byrhtnoth" relate to battles in Anglo-Saxon history.

In *Oceania; Linguistic and Anthropological* (Melbourne and London), the Rev. D.

MacDonald, missionary at Havannah Harbor, New Hebrides, presents a study of Polynesian languages and mythology. Though such studies must be for the present chiefly tentative, it is hardly possible to speak too highly of their value as aids in the investigation of the origins and migrations of the human races. The author of this study makes a critical and comparative analysis of a number of Oceanic dialects, and deduces the conclusion, from certain identities among them, that they all sprang from one inflectional mother-tongue, and this was a branch of the Shemitic family.

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POPULAR MISCELLANY.

The Function of a University.—President D. S. Jordan has a warning in one of his recent papers against attaching too much significance to numbers in estimating the usefulness of a university. The kind of work that students are doing is the really important consideration. One student in quaternions, or in Germanic philology, or trained to carry a scientific investigation to an end, is worth more than a dozen in trigonometry, or stumbling over the elements in Whitney's Grammar, or learning to analyze flowers or identify the muscles of a cat. Great numbers may mean crowded classrooms, overworked professors, and drudgery, instead of investigation, and the university a huge machine for lower education rather than a center for the discovery and dissemination of truth. "The highest function of the real university is that of instruction by investigation."

Death of the Rev. M. J. Berkeley.—The Rev. M. J. Berkeley, the distinguished English botanist, died July 30th, at Sibbertoft, near Market Harborough, in his eighty-seventh year. While his knowledge was very general, he was most eminent in cryptogamic botany, and particularly in the province of the fungi, in which he was a leading authority. He was born near Oundle in 1803. Having been graduated from Christ's College, Cambridge, he took orders as a clergyman, and occupied curacies in various places, adding to his income at times by taking pupils, and pursuing during his whole life the scientific researches that have given him fame. His earliest work was among the mollusca, but he soon turned his attention to botany, particularly to the study and classification of the cryptogams. Among his earlier researches were those into the nature of yeast and the vine mildew, the latter resulting in the discovery of the sulphur remedy. His descriptions of the British fungi in Dr. Hooker's "British Flora," published in 1836, constituted for more than twenty-five years the only text-book on the subject possessing any degree of completeness. The portions of Lindley's "Vegetable Kingdom" relating to fungi are also mainly Mr. Berkeley's work, and much of the matter relating to other orders of cryptogams was contributed by him. A more important and comprehensive work was his "Introduction to Cryptogamic Botany," published in 1857. He was associated with Lindley from an early period in the preparation of articles for the "Journal" of the Royal Horticultural Society relating to the influence of parasitical plants on growing crops and the application of vegetable physiology to purposes of cultivation. He was a valued contributor and kind of advisory editor to the "Gardener's Chronicle" from its establishment in 1841 to within a few years of his death; and in it he published a series of articles on vegetable pathology, which have not been collected. His researches on the potato disease made clear that it was caused by a fungus. Travelers became accustomed to submit to him for examination the fungi collected by them, and until within a year or two of his death he continued to publish descriptions of plants of this class from all parts of the world. He is credited by the "Athenæum" with having been among the first to recognize the necessity of studying the whole life-history of the plants before pronouncing a definite opinion as to their place in a natural scheme of classification; and to advocate and practice the culture of them for the observation of the transitions of their forms.

The Yellowstone Park Country.—According to Mr. Arnold Hague, geologist, the country across the Yellowstone Park plateau and the Absaroka Range presents a continuous mountain mass seventy-five miles in width, with an average elevation unsurpassed by any area of equal extent in the northern Rocky Mountains. It is exceptionally situated to collect the moisture-laden clouds which, coming from the southwest, precipitate immense quantities of snow and rain upon the cool table-land and neighboring mountains. The climate, in many respects, is quite unlike that of the adjacent country, the amount of snow and rainfall being higher, and the mean annual temperature lower. Rain-storms occur frequently throughout the summer, while snow is likely to fall at any time between September and May. Protected by the forests, the deep snows of winter lie upon the plateau well

into midsummer, while at still greater altitudes, in sheltered places, it remains throughout the year. By its topographical structure the park is designed by nature as a reservoir for receiving, storing, and distributing an exceptional water-supply, unexcelled by any area near the head-waters of the great rivers. The continental divide, separating the waters of the Atlantic from those of the Pacific, crosses the plateau from southeast to northwest. On both sides of this divide lie several bodies of water, which form so marked a feature in the scenery of the plateau that the region has been designated the lake country of the park. Yellowstone Lake presents a superficial area of 139 square miles, and a shore-line of nearly 100 miles. The discharge at the outlet was found in September, 1886, to be 1,525 cubic feet per second, or about 35,000,000 imperial gallons per hour. Dr. William Hallock estimates, from measurements, that the amount of water running into the park and leaving it by the five main drainage channels would be equivalent to a stream five feet deep, one hundred and ninety feet wide, with a current of three miles per hour, and that over an area of four thousand square miles the minimum discharge was equal to one cubic foot per second per square mile. For the preservation and regulation of this water-supply, the forest, which covers the mountains, valleys, and table-lands, and everywhere borders upon the lake-shores, is of inestimable value. Of the present park area about eighty-four per cent is forest-clad, mostly with coniferous trees.

The Glacier of Mount Tacoma.—Relating, in the "School of Mines Quarterly," an excursion to the great glacier of Mount Tacoma, Mr. Baily Willis describes the glacier, when the party came upon it from the bed of Carbon River, as rising, like a wall of ice, from thirty to fifty feet, across the path, while the river tumbled in little cascades from a low cave in the center. The upper surface of the wall, all its sharp ends having been melted off, was covered with a layer of rock and earth. "I think," says the author, "there can be no better illustration of the advance of a glacier to the point where the melting at its face balances the downward progress, than this worn, shrunken extremity, pressed on as it is by a vast accumulation of ice in the basin between Tacoma and Crescent Mountain. It pushes no great terminal moraine before it. It meets with no obstruction save the narrowness of the cañon; but here in the shadow of the cliffs the air-currents from the west bid it halt." The Crescent Mountain glacial system is fed by slopes which descend ten thousand feet in five miles from the Liberty Cap, Tacoma's northern summit. "Much too steep for snow to lie on, except on the highest shoulders where it packs to a depth of several hundred feet, the upper third of this tremendous height is bare black rock, on which the avalanches shatter into clouds of eddying smoke. The lower four miles are covered with a sheet of flashing ice, which pushes downward over the uneven surface, here carrying huge gleaming pinnacles aloft, there flowing in graceful curves like a river's current. Its western portion comes onward to the cliffs of Crescent Mountain, nearly three thousand feet high, and turning from them sweeps down into the gorge of Carbon River; the eastern part extends a long tongue into a meadow brilliant with flowers, whence White River plunges into its unexplored cañon. This meadow is but one end of a green valley that nestles strangely in this region of perpetual frost and sterile rocks, bounded on three sides by ice and snow, and on the fourth by forbidding precipices."

Origin of New Forest Growths.—Observations on the "new growth" of trees that appears after forest fires have been described by Prof. W. J. Beal, of the Michigan Forestry Commission. The stubs of most deciduous trees sprout after a fire, and are capable of preserving their vitality for a very long time. Slender oaks, resembling young sprouts, may be found in the forests attached to clumped roots of "grubs" of various sizes, that will show that the present growth is the first, second, third, or fourth sprout that has apparently come in succession from the same foundation. Of three little oaks which were found still having the remains of the seedling acorns attached by the stems of the cotyledons, one was five years old. Others, some four inches high and less than an eighth of an inch in diameter, were shown by the remains of the bud-rings to be from

four to ten years old. "It is not difficult to find white oaks under eighteen inches high that are twenty or more years old, and then this may be the second, third, or fourth sprout that has followed in succession, so that it is not improbable that in some of the cases seen the parent root or grub was from sixty to one hundred years old; and the whole now not an inch in diameter anywhere above the ground. Then what shall we say of the age of some grubs that weigh from thirty to fifty pounds each?" Pines and hemlocks will not grow from stumps, but the seeds have a vitality corresponding to that of the deciduous "grubs." In the cone they may be preserved with hardly impaired integrity for five or six years; and cones of *Pinus Banksiana* have been seen, unopened and apparently perfect, that were ten or fifteen years old. "I feel confident," Prof. Beal says, "that, in an hour or two spent in a certain favorable place, I could fully satisfy any intelligent person, unless he be unusually stubborn, that it is an easy matter to prove that new forests spring from seeds or the stumps of the old, and that, when the second growth is in some respects unlike the first, the change is accounted for in a rational manner."

The Oyster-Garden of Arcachon.—The great oyster-garden at Arcachon, France, is a basin on the Bay of Biscay, connected with the Atlantic only by a very narrow opening, and is sixty-eight miles in circumference and protected from winds by the pine-clad heights that surround it. The waters are salt enough and yet not too strong, the bottom is of the gravelly sand favorable to oyster-breeding, and the rise and fall of the tide are such that the basin is completely covered at high tide and the beds are largely uncovered at low water. The oyster has always been an inhabitant of this spot. The stock had become nearly exhausted forty years ago, but has been recruited by individual enterprise under the encouragement of the Government. There are now 12,500 acres of oyster-beds in the basin. Several thousand men and women are employed to attend them, and the average annual sale of oysters by the principal firm is over 200,000,000. As the majority are not sold under two years old, and these only for relaying, it is computed that there are usually 500,000,000 oysters of various ages upon these beds. The beds having been artificially made, the whole process of oyster-breeding can be witnessed there. They are laid out in parks, each park embracing twenty or more beds, and between the parks, as between the sections of the beds, are water-ways for the passage of boats. The beds are made of sand and gravel, upon foundations of wooden piles, and raised above the level of the basin bottom, but not to such an extent as to expose them at other than low tides. A barrier of "switches" or nets protects the beds from fishes. Sets of earthenware tiles are arranged for the reception of the young oysters or "spat," coated with mortar, so that anything fixing itself to them may be scraped off easily. Sometimes each of these tiles will be covered by five hundred or six hundred young oysters. They develop rapidly, and in about a month take the form of real miniature oysters. Then they need more room, and are thinned by scraping, to be placed wider apart on other tiles, or to be transferred to their final beds, or to wire-bottomed trays.

A Navajo Tanner.—Dr. Shufeldt has succeeded in witnessing the complete process of tanning a buckskin by a Navajo Indian. He had difficulty in inducing the tanner to bring his work where it could all be performed before his eyes, because of a superstition that the hide must be removed on the spot where the animal is slain, or the hunter will lose his eye-sight before the next moon. The present hunter, however, perhaps tried to avoid this doom by beginning some of the preliminaries of his work before removing the animal. The skin was taken off with great dexterity in manipulation, and laid in a hole dug in the ground and filled with spring-water till the next morning. It was then taken out, washed, cleansed with a knife, and dipped in clean water. The tools for shaving off the hair were obtained from the animal itself, being parts of the bones of the fore-leg. The skull of the deer, which had been kept through the night in the ashes of a low camp-fire, was split, and the brains were taken out. They were then manipulated in a basin of tepid water for the removal of splinters of bone, and left to sim-

mer for an hour. When the water, not so hot but that the hand could be held comfortably in it, had become of a muddy color, the tanner took out the brains and rubbed them in the palms of his hands till they were dissolved into a pasty mass. The skin was hung upon a tree and wrung and twisted into a hard coil, and kept in that position for nearly an hour. It had then apparently shrunk to two thirds of its size, and had to be pulled into shape again. This done, it was spread out, hair side up, and thoroughly rubbed with the brain solution. The effect of this was to give it softness and pliancy. The skin, folded into a kind of ball, was wrapped in a buffalo-robe, and exposed for a few minutes to the sun, for the purpose, as the Indian said, of letting "the brains go well into him." It was then unwrapped and spread out to dry. On the next morning it had shrunken again to one third of its original size, was hard, appeared almost brittle, and was half-transparent. It was then soaked in cold or tepid water, washed and rinsed, wrung and "twisted and retwisted upon itself"; again stretched and manipulated into shape, pulled this way and pulled that, worked at the edges to get them limp and pliant, and at the ears and the skin of the legs. "But during all this time an interesting change was coming over it: the heat of an August sun was rapidly drying it, it was fast coming to be of a velvet-like softness throughout, and, attaining its original size, it was changing to a uniform pale clay-color. The hair side was smooth, while the inside was roughish. Indeed, in a few moments more it was buckskin." Then, with the aid of a wooden awl, the tanner stretched the skin of the neck transversely with great force, cut his mark on either side near the ear, and the fabric was finished and spread out for its final drying.

Architecture.—Discussing the question, What style of architecture should we follow? Mr. William Simpson observes that we should follow no style to copy it, or as the ultimate object to be reached, but may use any style with the intention of developing new forms from it. A new style, if we want one—and every people and every age should have its own—can not be evolved out of the inner consciousness of any man or any number of men, but is possible only by practical working. It can only be produced by a course of development requiring time, during which the requirements of the period and the building materials should be the dominating factors. This will produce the constructive forms by a natural process. Then follows the æsthetic or decorative function, in which the artist should be a designer and not a copier. Some style, however, should be taken from which to start. All previous styles have been developments from pre-existing ones. Such has been the condition in the past, and by accepting this we would not be ignoring the experience of what has taken place. The process of adaptation should be begun by weeding out all shams. Let all forms which are not suited to the present wants and conditions be rejected. The same should be done with all constructive forms that are not natural, or which would be bad building if produced with the material employed. No structural form should be added to a building which is not required, and with no other object than that of "architectural effect." This has been a prolific cause of shams. Such things as pinnacles, turrets, towers, and all sorts of useless excrescences have come into existence under this supposed necessity. All decoration which is founded on, or the representation of, previous constructive forms, should be rigidly avoided; and originality in design should be understood as the aim of all decorators.

A Problem in Human Character.—A very paradoxical character is described in the autobiography of Solom Maimon, "vagabond Talmudist," and one of the most learned men and sharpest casuists of the Hebrew race. He appears there, according to the summary of a reviewer of the work, as a "skeptical rabbi, a great Talmudist who despised the Talmud, an omnivorous reader of all such science as in the last century a Polish Jew could get hold of, a genuine idler in literature, who, although he could dash off a considerable spell of work in a short time, had no work in him, had no method in him, and always preferred slip-shod effort to steady industry; a man whom want and misery had reduced into spasmodic fits of intemperance, which rather grew upon him toward the end." With all this

he spent a half-year of his life as a regular professional beggar — adopting apparently all the habits and feelings of a beggar. "None the less he was a man of remarkable acquirements, being a learned Talmudist, for those times at least a considerable mathematician, and having in middle life mastered Latin, German, French, and English, besides the various Eastern dialects of which his Hebrew knowledge was the foundation. He had evidently a very great turn for physics as well as for mathematics, and a wonderful capacity for the acquisition of languages without the slightest communication with those who could speak them, so that he knew a language fairly well of which he could not properly pronounce a single sentence." He so criticised Kant's greatest work as to excite the admiration of the author. In character "he was candid, grateful, generous, and full of kindly feelings. But he was conceited, irreverent, passionate, intolerant of the influence of others, and never really at ease among the class for which his knowledge fitted him. His study of the Talmud . . . thoroughly unfitted him for feeling the least respect for the element of authority in religion." The questions are suggested whether Maimon's vagabond tastes stimulated his intellectual restlessness, or his intellectual restlessness stimulated his vagabond tastes; whether he would have been as keen if he had been a home-stayer and steady worker, or whether it was his taste for wandering and his unsettled habits that really made his intelligence so bright. Much might be said on both sides of these questions; but the probability is, that Maimon would have been stronger and more useful, though, perhaps, less diversified and brilliant, if he had led a regular life.

An Anti-Lightning Cage.—Besides the orthodox or "gather-up-and-carry-away" system of protection against lightning there is another system suggested by Clerk Maxwell—the "bird-cage" or "meat-safe" principle. "In a banker's strong room," says Prof. Lodge, "you are absolutely safe. Even if it were struck, nothing could get at you. In a bird-cage, or in armor, you are moderately safe. . . . A sufficiently strong and closely meshed cage or netting all over a house will undoubtedly make all inside perfectly safe—only, if that is all the defense, you must not step outside, or touch the netting while outside, for fear of a shock. . . . An earth-connection is necessary as well." A wire netting all over the house, a good earth-connection at several points, and a plentiful supply of barbed wire stuck all over the roof, constitute an admirable system of defense. Points to the sky are recognized as correct; but there should be "more of them, any number of them, rows of them, like barbed wire—not necessarily at all prominent—along ridges and eaves. For a single point has not a very great discharging capacity; and, if you want to neutralize a thunder-cloud, three points are not so effective as three thousand. No need, however, for great spikes and ugly tridents, so painful to the architect. Let the lightning come to you, do not go to meet it. Protect all your ridges and pinnacles—not only the highest—and you will be far safer than if you built yourself a factory-chimney to support your conductor upon."

A Giant Earthworm.—An earthworm which, in some examples, reaches the length of six feet, is described by Prof. Baldwin Spencer, in the "Transactions of the Royal Society of Victoria," as existing in Gippsland, Australia. It is the *Megascolides australis*, one of a group peculiar to Australia, of which five species are known. When found at all it is somewhat abundant, and lives principally on the sloping sides of creeks. At times it is found beneath fallen logs, and may be turned out of the ground by the plow. The worm itself does not appear to leave a "casting" at the mouth of its burrow, but often lives in ground riddled by the holes of the land-crab, which forms a "casting." Hence, contradictory statements have been made about the worm's having a "casting." The presence of the worm underground may be recognized by a very distinct gurgling sound which is made by the animal retreating in its burrow when the ground is stamped upon by the foot. When once heard, this gurgling sound is unmistakable. By its rapid motion and its power of distending any part of its body at will, so as to make it fit very tightly in its hole, the worm contrives to make itself very hard to catch. It has a characteristic odor,

somewhat resembling that of creosote, which is very strong and unpleasant in the dead animal. The body, in decaying, passes into a fluid, which the natives of the district say is good for rheumatism. Fowls refuse to touch it, living or dead. When held in the hand the worm, in contracting its body, throws out jets of a milky fluid; and this fluid seems to be the substance which it uses for coating its burrows to make their walls moist and slippery. The worm moves in its burrow by swelling up one or the other end and pulling or pushing itself along from that. Outside of the burrow it does not attempt to get along. The burrows of the large worm measure from three quarters of an inch to an inch in diameter. In disused burrows are often found casts of the worms, and, more rarely, cocoons containing a single embryo. The cocoon is thin, and made of a leathery, tough material, with a very distinct stalk-like process at each end. It contains a milky fluid like that found in the body cavity of the worm.

Fishing in the Greek Islands.—Mr. J. Theodore Bent has been struck, in his visits among the islands of Greece, by the observation of many survivals of ancient ways in the customs of the people, and this very noticeably in the fishing. In fishing for "shell-fish," the fishermen use a long trident, with more prongs than Neptune's had, but otherwise like it, and which they call by the old name καμαξ. The fishermen of Hydra make bulwarks of netted osiers, like those which Ulysses made for his two-decked raft when he left Calypso's charmed island. The scaros is pursued in the way that Oppian sings of in his poem on fishing. Taking advantage of the affectionate character of the scaros and of the male's gallant devotion to the female, the fisherman fastens a female fish to his line. If the "bait" is dead, he imitates life by bobbing it up and down. The male scari rush up in shoals to rescue their female fellow, and are caught by a companion-fisher with a net. For tunny, nets are used having large openings and furnished with a thick string. A bay is chosen with a convenient promontory, from a post on which the nets are fastened, while the fishermen row out to a rock in the sea. Here they leave a man, and return to shore by a roundabout route, carrying a string with them by which they can pull in the net as soon as the man on the rock announces the arrival of the fish. The same method is described by Aristotle in his book on animals. If the market is overstocked with tunny, the fish are driven into a creek by throwing stones at them and the entrance is fastened up with brambles. The fishermen in Melos believe in an ogre called Vanis, a being with goat's feet and a human body—a satyr, in short—who dwells at the end of a promontory they have to pass in going out of their harbor. They always cast a bit of bread into the water as they go by, that Vanis may eat it and send them fish in return.

Studies at Wundt's Psychological Laboratory.—Wundt's psychological laboratory at Leipsic occupies four rooms in the university building. The number of students has gradually increased, and in 1887 was nineteen. The men work in groups, one acting as subject in the experiments, and another making observations. Wundt suggests subjects for research at the beginning of the semester, but he lets the students choose the direction in which they prefer to work, and encourages them to find independently problems and the methods of solving them. The experiments are classified by Dr. J. Mck. Cattell under four heads: 1. The Analysis and Measurement of Sensation. 2. The Duration of Mental Processes. 3. The Time Sense; and 4. Attention, Memory, and the Association of Ideas. Under the first head are included experiments in the least differences in weight, intensity, and tone of sound, illumination, and color that can be perceived—the whole being embraced under the term *psychophysics*. In the subjects under the second head, constituting psychometry—"the facts obtained when we learn how long it takes to perceive, to will, to remember, etc., are in themselves of the same interest to the psychologist, as the distances of the stars to the astronomer or atomic weights to the chemist"; they help in the analysis of complex mental phenomena, and in studying the nature of attention, volition, etc. Psychometrical experiment has brought perhaps the strongest testimony we have to the complete parallelism of physical and

mental phenomena; and "there is scarcely any doubt but that our determinations measure at once the rate of change in the brain and of change in consciousness." There is also a general interest in the study. "Time, like size, is relative. The time-sense, involving the time-relations of perceptions and our power of estimating intervals of time, is to a considerable extent a physiological fact due to inertia in the sense-organ. Stimuli must be separated by a certain interval of time in order that they may be recognized as distinct. The experiments under this head relate to the measurement of these intervals. The experiments in attention, memory, and the association of ideas are varied, and cover some matters included under the other heads. The highest degree of complexity and the lowest degree of intensity and interest which our consciousness can grasp; the number of things—lines, letters, etc.; the relative visibility of colors and legibility of letters of the alphabet; the intervals between maxima of intensity and sensation, or rhythm of sensation; the time it takes for an idea to suggest another; and many similar studies—are related to it.

Inebriate Asylums and their Work.—Dr. T. D. Crothers remarks, as a curious fact, that inebriety was recognized as a disease long before insanity was thought to be other than spiritual madness and a possession of the devil. The first inebriate asylum was opened at Binghamton, N. Y., under Dr. J. E. Turner, after eight years of effort. It was conducted with much success for a time, but went down in the hands of trustees. The Washingtonian Home of Boston, opened in 1857, is now treating about four hundred cases every year. The Kings County Home, of Brooklyn, was opened in 1867, and is crowded with patients. The Chicago Washington Home, opened in 1867, and the Franklin Home, Philadelphia, opened in 1872, are in successful operation. The first two institutions proceed on the theory of disease. The Chicago Home and the Philadelphia Home regard religion, education, and pledges as sufficient to restore the patients, and consider a short residence at the hospital better than long treatment. More than fifty hospitals for inebriates have been started in America, over thirty of which are in successful operation. The others have been changed into insane asylums, water-cures, etc. About twenty asylums for inebriates are open in England and Scotland. Others exist in Melbourne, New Zealand, Germany, and Switzerland, and new ones are projected in Norway, Sweden, and France. The value of the results of the asylum treatment has been estimated from the answers to letters of inquiry addressed to friends of patients several years after dismissal. Of one thousand patients at Binghamton, sixty-eight and a half per cent continued temperate after five years; of two thousand at the Boston Washingtonian Home, thirty-four per cent after from ten to eighteen years; of six hundred at the Kings County Home, thirty-four per cent after ten years. The most careful authorities in the United States are agreed that fully one third of all cases that come under treatment are permanently cured.

The Gnawers of the Selkirk Mountains.—The heaps of bowlders above the forest region in the Selkirk Mountains of British Columbia, says the Rev. W. S. Green, "form a refuge for a variety of mammals — the hoary marmot, measuring about three feet long, being the commonest and most useful from a commissariat point of view. This creature gives a loud, shrill whistle; so weird does it sound in these solitudes that it returns to one's ears as an inseparable memory of the Selkirk valleys. The serrellel is a strange beast; it too lives beneath the bowlder-heaps, and it has the most wonderful fancy for collecting flowers. One day, when we were ascending a glacier moraine, my cousin said to me, 'Some one has been here before.' I said, 'Impossible!' but was utterly puzzled by finding a bouquet of flowers plucked, with their stems lying neatly together, just as though some child had laid them down. Soon afterward we found similar bouquets at the burrows of these animals. What their particular object in collecting flowers is, it is difficult to understand; making hay for winter use I have seen suggested. Mountain rats, chipmunks, little chief hares, and other creatures are also common in these regions, rendering *caches* of provisions useless, unless tinned meats alone are hidden. My Alpine rope was nibbled into little bits in one night, and on

another occasion some beast gnawed a hole through the tent while we were asleep, and ate the bread which I was using for a pillow. A skin I hung up to dry on the tent-rope vanished, and the scampering of little feet up and down the outside of the tent commenced every night the moment we retired to rest."

A Country of Salt.—Everything in the country of the river Chaï, in Central Asia, is described by Gabriel Bouvalot as covered with salt. It is seen in the walls of the houses and on the banks of the rivers, and the water one drinks is very salt. Traveling saltpeter-makers go in summer from place to place wherever they can find materials to work upon. Their mode of operation is a rough-and-ready one. Holes in the earth serve as vats and boilers, and below these are placed ovens. Abundance of brushwood supplies material for the fires. The workers collect from the surface of the earth heaps of a compost of salt and animal manure. This is soaked for twenty-four hours in water, then filtered, and then boiled for twenty-four hours, cleansed, and placed in the sun, so that the water may evaporate. An ordinary workman can make about fifty pounds in a day, and this he sells at the rate of a penny a pound. The workers appear quite contented with their lot, and the industry is preserved in their families for generations.

NOTES.

Several "effigy mounds" in the Rock River Valley, Ill., have been described by T. H. Lewis. The "Rockford Turtle" is 184½ feet long and from three to five and a half feet high, and stands in the midst of the best part of Rockford. It is associated with a bird-mound, seven round mounds, and two embankments. An animal mound in Jo Daviess County is 216 feet long, with an average height of five and a half feet, has its fore-feet resting on an embankment, and is associated with twenty-three other mounds and two embankments. A bird effigy on the east side of Rock River some five miles below Rockford, and an animal 116½ feet long at Freeport, are described. Few of the Illinois effigy mounds are in good preservation.

A marked difference is observed by Dr. George M. Dawson, of the Geological Survey of Canada, as between the maritime Indians of the coast and the Indian tribes of southern British Columbia. While it is largely one of habit and mode of life, it is also almost everywhere coincident with radical differences in language. The natural tendency to diversity as between coast-inhabiting fishermen and roaming hunters is intensified and perpetuated by the barrier of the Coast Range. The diversity breaks down to some extent only on certain routes of trade between the coast and the interior.

The distinction of the Legion of Honor has been conferred upon Prof. C. V. Riley by the French Government. The Minister of Agriculture, writing to Prof. Riley on the subject, said that in awarding the honor the Government had sought to reward the important services which he had rendered to agriculture generally of all countries, and particularly to France, by his labors and discoveries.

A case of poisoning by mackerel was recently established at a coroner's inquest in London. The deceased, who had eaten a part of the fish adjacent to the head, was attacked with gastritis and pneumonia, became delirious, and died; while his wife, who ate another part of the fish, suffered no inconvenience. The gills of the mackerel appearing to have undergone fermentation, the victim's illness was ascribed to his having eaten decomposed fish. Cases of this kind, which used to be regarded as unaccountable, are now considered due to the presence of ptomaines developed by decomposition.

A peculiar tendency in idiots to imperfections and disease in the teeth has been noticed by several physicians; and it has been studied by Madame Sollier in a hundred cases of idiots taken at random. The multiplicity and variety of the dental lesions were remarkable; and the conclusion has been drawn that idiocy, with or without epilepsy, predisposes to arrests of development and to anomalies of dentition. The effect rarely appears in the first teeth, however, but almost wholly in the second.

Mr. Carruthers, President of the Linnæan Society, has found that seven original and authentic portraits of Linnæus are in existence. The most widely known engravings are from the originals by Inlander and Roslin; and these give the most faithful representations of the features of the great naturalist.

An instantaneous photographic apparatus is proposed to take the place of the judge at the winning-post in race-courses. Its value is seen in very close races, when the judges can not decide accurately, and in what are called "dead heats," when two or three horses appear to reach the winning-post at exactly the same time. The photograph will show one of the horses to be an inch or so ahead, and decide in his favor.

WORKS have been erected in London by Mr. William Webster for experiment upon an electrical treatment of sewage that has been devised by him. Electricity is to be applied directly, to resolve the matter into its chemical elements and secure a precipitation in the form of sludge.

A LARGE exhibition of prehistoric objects, representing public and private collections in Austria, is to be given in connection with the next Congress of German Anthropological Societies, which is to meet this year in Vienna.

THE oldest man in Great Britain is Hugh McLeod, crofter, of Ross-shire, Scotland, who was born in 1783, and is consequently in his one hundred and seventh year. He is still straight and good for a full day of wakefulness, and cuts his own peat and carries home his daily load of eighty-four pounds. He eats porridge and milk, potatoes, fish, and mutton when he can get it, has cultivated a fondness for tea, and is "very heavy" in chewing "thin twist." His father was a weaver, and he has been a carpenter and joiner. There are three other centenarians in the same parish.

MR. GOSCHEN has traced a connection between the use of the cigarette after dinner and a decline in the consumption of wine at table. The friends of the cigarette claim that it is convenient, is adapted to various kinds of employments, is cheap as compared with good cigars, and makes less demand than a pipe upon the manly powers. Its opponents hold that it is adulterated with deleterious ingredients which provoke the head and throat, and stimulate the desire to drink; that it blunts the delicacy of the taste and encourages promiscuous drinking; and that it leads to the spending of much money—all in addition to the harm there may be in smoking at all.

THE Kina Balu, or "Chinese Widow," the great mountain of Borneo, rises thirteen thousand seven hundred feet from a low undulating country, at about twenty-five miles from the west coast of the island, and is regarded with a kind of religious awe by the natives. Its slopes abound with pitcher-plants and *Nepenthes* generally. It has been partially ascended by the travelers Lobb, Low, and St. John; and its real summit was reached, according to Mr. R. T. Pritchett, last year by Mr. Whitehead. This traveler has spent several years of hard work in exploring, and has brought back many before unknown varieties of birds.

FIVE cases of ruptured tympanum, described by Dr. W. R. H. Stewart, admonish us to be careful how we treat the ear. One was of a boy whose ear had been boxed by his teacher; another, of a woman who had received a blow in a scuffle with her husband; a third, of a man sixty years old, who had suffered from deafness and an offensive discharge ever since having been struck when a boy. In the fourth case, a laborer had been made deaf and partly lost the sense of taste in consequence of a blow on the side of the head. The last case was that of a woman who had accidentally perforated her tympanum while picking her ear with a hairpin. Pains and deafness were common to all these cases. All were improved, and most of them were cured, by treatment.

SYMPTOMS of poisoning were recently developed in the case of some persons in Berne, Switzerland, who had eaten of the mushroom *Morchella esculenta*. On investigation a highly poisonous substance was found in the sample—identical with that which had been eaten—resembling the ptomaines, and like them, probably, a result of partial decomposition. The warning is against stale fungi.

ARSENIC has been detected in a sample of matches obtained in Jena, Germany, which are characterized by the heads having a black covering with a metallic luster, and containing much lead, partly present as red lead. The quantity of arsenic was so small as to be detected only by the most delicate tests.

OBITUARY NOTES.

DR. C. JESSEN, naturalist, formerly professor at Greifswald, and more recently at Berlin, has lately died, in his sixty-ninth year.

PROF. ELIAS LOOMIS, LL. D., of the Munson chair of Natural Philosophy and Astronomy in Yale University, died August 15th, in his seventy-ninth year. He was graduated from Yale College in 1830, and three years later became a tutor there. He and Prof. A. C. Twining, of West Point, together began the first observations made in this country to determine the altitude of shooting-stars. In 1835 he discovered Halley's comet on its return by means of his own computations of the elements of its orbit. He was the author of text-books covering the whole range of mathematical subjects; of popular treatises on natural philosophy, astronomy, and meteorology; and of many contributions to scientific journals.

DR. JOHN PERCY, a distinguished English metallurgist, died June 20th, aged about seventy-two years. He was appointed Professor of Metallurgy in the School of Mines in 1851, and held the office till 1879. He began his great work on metallurgy in 1861, and continued it in 1864, 1870, and 1880. He received the Bessemer medal of the Iron and Steel Institute for his researches in metallurgy, particularly in iron and steel, in 1877. He was elected a Fellow of the Royal Society in 1847, and President of the Iron and Steel Institute in 1886. He was also distinguished for labors in practical ventilation.

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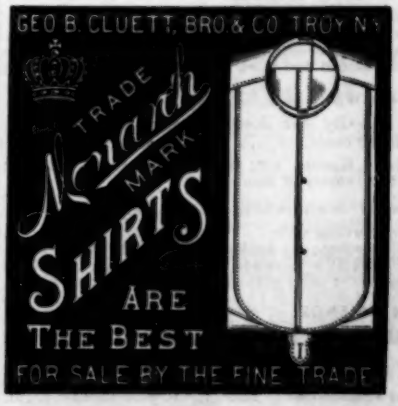

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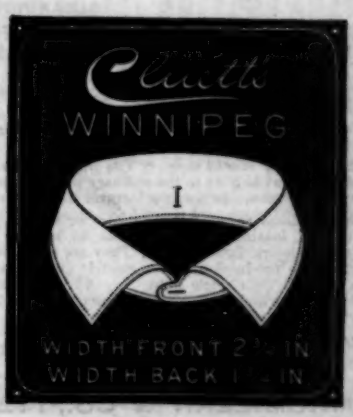

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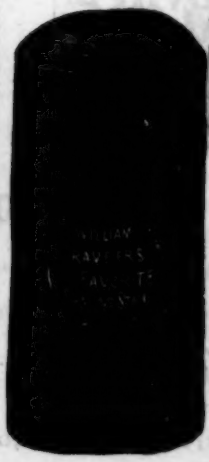

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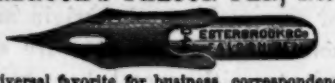

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JULY, 1889.

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		$89,824,336 19

ASSETS.

Cash on deposit, on hand, and in transit	$2,695,836 94	
United States bonds and other bonds and stocks (market value, $36,222,751 94)	34,566,901 58	
Real estate	9,348,152 28	
Bonds and mortgages, first lien on real estate (buildings thereon insured for $13,800,000 and the policies assigned to the Company as additional collateral security)	18,986,932 50	
Temporary loans (market value of securities held as collateral, $2,144,670)	1,676,230 00	
*Loans on existing policies (the reserve on these policies, included in liabilities, amounts to over $2,000,000)	378,874 10	
*Quarterly and semi-annual premiums on existing policies, due subsequent to January 1, 1889	1,433,734 88	
*Premiums on existing policies in course of transmission and collection. (The reserve on these policies, included in liabilities, is estimated at $1,300,000)	1,045,089 46	
Agents' balances	298,959 43	
Accrued interest on investments January 1, 1889	451,605 24	$89,824,336 19
Market value of securities over cost value on Company's books		3,655,850 36

* A detailed schedule of these items will accompany the usual annual report filed with the Insurance Department of the State of New York.

TOTAL ASSETS, January 1, 1889 ..... $93,480,186 55

Appropriated as follows:

Approved losses in course of payment	$355,535 62	
Reported losses awaiting proof, etc.	902,904 77	
Matured endowments, due and unpaid (claims not presented)	56,511 88	
Annuities due and unpaid (claims not presented)	26,865 69	
Reserved for reinsurance on existing policies, at the Actuaries' tests 4 per cent. interest	78,963,737 00	
Reserved for contingent liabilities to Tontine Dividend Fund, January 1, 1888, over and above a 4 per cent. reserve on existing policies of that class	$3,315,720 83	
Addition to the fund during 1888	2,043,865 84	
	$7,359,586 67	
DEDUCT— Returned to Tontine policy-holders during the year on matured Tontines	935,809 54	
Balance of Tontine Fund January 1, 1889	6,423,777 13	—
Reserved for premiums paid in advance	46,504 21	
		$86,397,936 50
Divisible surplus (Company's new standard)		7,082,250 05
		$93,480,186 55
Surplus by the N. Y. State standard (including the Tontine Fund)		13,500,000 00

From the undivided surplus, as above, the Board of Trustees have declared a reversionary dividend to participating policies in proportion to their contribution to surplus, available on settlement of next annual premium.

Returns to Policy-holders.	*Insurance in Force.*	*Assets.*	*New Policies Issued.*
1886 ..... $7,627,290	Jan. 1, 1887 .... $304,373,540	Jan. 1, 1887 .... $75,421,453	1886 32,097
1887 9,535,210	Jan. 1, 1888 358,935,536	Jan. 1, 1888 83,079,845	1887 28,522
1888 10,973,070	Jan. 1, 1889 419,886,505	Jan. 1, 1889 93,480,186	1888 33,334

Number of policies issued during the year, 33,334. Risks assumed, $125,029,731.
Total number of policies in force January 1, 1889, 129,921. Amount at risk, $419,886,505.

TRUSTEES:

WILLIAM H. APPLETON, WILLIAM H. BEERS, WILLIAM A. BOOTH, HENRY BOWERS, JOHN CLAFLIN, ROBERT S. COLLINS, ALEX. STUDWELL, ELIAS S. HIGGINS, WALTER H. LEWIS, EDWARD MARTIN, RICHARD MUSER, C. C. BALDWIN, JOHN N. STEARNS, WILLIAM L. STRONG, W. F. BUCKLEY, HENRY TUCK, A. H. WELCH, L. L. WHITE.

WILLIAM H. BEERS, President.
HENRY TUCK, Vice-President.
ARCHIBALD H. WELCH, 2d Vice-Pres.
RUFUS W. WEEKS, Actuary.
THEODORE M. BANTA, Cashier.
A. HUNTINGTON, M. D., Medical Director.

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